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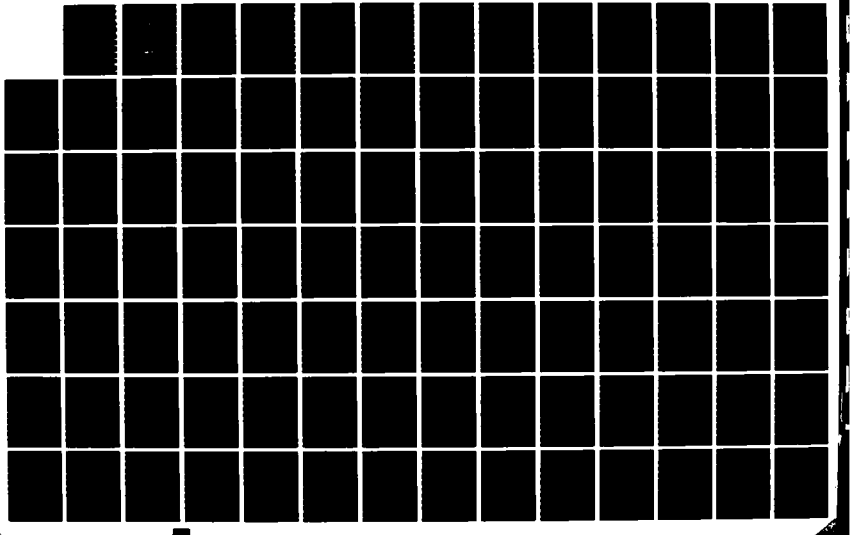

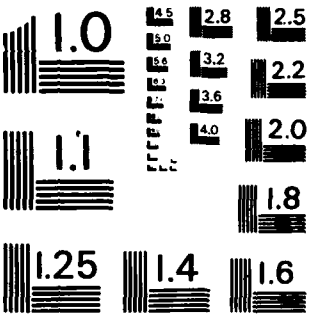

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Computer-Aided Engineering and Documentation System (CAEDOS) Productivity Study, Director of Navy Laboratories Research and Development Centers

by
Computer Resource Technology Corporation
for the
Computer Aided Engineering Program Office
Engineering Department

APRIL 1986

NAVAL WEAPONS CENTER
CHINA LAKE, CA 93555-6001

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Naval Weapons Center

FOREWORD

This report covers a survey to measure the productivity increases attributable to the use of Computervision CADDS 4 and 4X CAD/CAM systems installed at Navy laboratories under the Computer-Aided Engineering and Documentation System (CAEDOS) contract. The survey was conducted by Computer Resource Technology Corp. as a subcontractor to Computer Sciences Corp. under Subcontract CSC-ATD-85-0-102, NWC, China Lake Delivery Order GM 8J-1, under Prime Contract No. N00123-84-D-0003, and was initiated in February 1985, and was conducted during May, June, and July 1985.

The report has been reviewed for technical accuracy by John Denson.

Approved by
D. J. RUSSELL, *Head*
Engineering Department
31 March 1986

Under authority of
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Capt., USN
Commander

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(U) This report covers a survey to measure the productivity increases attributable to the use of Computervision CADDS 4 and 4X CAD/CAM systems installed at Navy laboratories under the Computer-Aided Engineering and Documentation System (CAEDOS) contract. The survey was initiated in February 1985 and conducted during May, June, and July 1985.

(U) CAEDOS has resulted in productivity benefits at the Navy laboratories surveyed, primarily in the mechanical and electrical engineering design and the drafting and detailing areas. Recommendations are to (1) accelerate training in use of 3-D modeling for engineers and designers, (2) procure or develop CAEDOS compatible mechanical and electrical analysis software tools, (3) define numerical control (NC) (Contd. on back)

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postprocessors to support all NC machine tools at each laboratory, (4) provide training in advanced subjects on schedules convenient to the trainees, (5) restructure the CAEDOS management functions at certain laboratories, (6) improve system availability, (7) establish a program to educate laboratory top management in benefits of use of CAD/CAM and CAE at each laboratory, and (8) procure or develop internal communication interfaces between CAEDOS and the large mainframes at each laboratory and between CAEDOS and the smaller stand-alone CAE workstations.

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CONTENTS

EXECUTIVE SUMMARY

A survey to identify the productivity improvements attributable to the Computer-Aided Engineering and Documentation System (CAEDOS) installed at Navy laboratories was conducted during May, June, and July, 1985, at the Director of Navy Laboratories Research and Development Centers. CAEDOS is Computervision's CADDS 4 and 4X systems, including all hardware and both operating systems, utility and application software for computer-aided design, analysis, drafting, and manufacturing in the mechanical, electrical, architectural, engineering and construction, manufacturing, and publications areas. There are 188 CAEDOS workstations installed at the 13 Navy laboratory sites surveyed. There were 577 individuals identified at the laboratories as CAEDOS users; 179 of whom were classified as full-time (i.e., 5 hours per day or more), and the remainder, part-time or intermittent users.

In all, 191 CAEDOS users participated in the survey, 48% of the 179 full-time users and 31% of the 577 full-, part-time, and intermittent users. The survey participants also included 35 managers or supervisors. Because of this relatively high percentage of CAEDOS users, the quantitative and qualitative results of the survey are considered to be highly representative of the impact CAEDOS has had on productivity at the laboratories surveyed.

No clearly definable correlations were found between age, educational background, and prior experience with computers and level of satisfaction with CAEDOS, or productivity benefits reported. The majority of the laboratory participants indicted that CAEDOS made a significant contribution to the quality of work being performed and helped the individual do a better job. The survey also indicated that participants were not satisfied with CAEDOS availability; i.e., too much system downtime because of hardware or software maintenance problems, and in one laboratory, an attendant loss of work.

Of the survey participants, 49.3% used the system exclusively for mechanical, 18.8% exclusively for electrical, and 13.1% exclusively for architectural applications. The remaining 18.8% of the participants used the system for multiple applications. System usage by application area could not be computed based on the survey data.

Overall productivity improvements attributable to CAEDOS were computed to be 1.7:1. The productivity benefits reported in the detailing and drafting applications in both mechanical and electrical areas were higher than the benefits in the design area. Overall benefits in the electrical and mechanical applications were generally the same. The survey results indicate that CAEDOS is being used primarily as a drafting and detailing system rather than as an engineering design tool. Additionally, the survey indicated that CAEDOS is being used only to a very limited extent for mechanical and electrical analysis because of the lack of analytical tools on the CAEDOS as well as the lack of interface between CAEDOS and other systems on which analytical systems are used.

Use of CAEDOS for architectural engineering and construction (AEC) applications offer considerable productivity improvement potential in the Public Works departments of the laboratories, particularly in the facilities management area; i.e., for documenting the existing plant and facilities and for associated planning.

For CAEDOS to help individuals do a better job, the principal need expressed by survey participants was for additional training, primarily advanced training, made available on a schedule and in increments convenient to the engineer or trainee rather than at the instructor's convenience.

Next to training, the survey participants expressed a need for additional software capabilities for CAEDOS, principally in the computer-aided engineering (CAE) analysis area, finite element analysis, parts libraries, solids modeling, and numerical control (NC) postprocessors.

As indicated earlier, system nonavailability because of hardware or software maintenance problems, software "bugs," and uninterpreted error messages were all a source of dissatisfaction among CAEDOS users.

The last major area commented on by the survey participants was management support for CAEDOS at each of the laboratories. It is impractical to expect system managers to accomplish all of the software engineering, application engineering, system operations, and management and administrative tasks that are expected of them. These expectations lead to frustation among the users and system managers as well as a high turnover in managers at some of the laboratories.

INTRODUCTION

The objective of this survey was to measure the productivity increases attributable to the use of Computervision (CV) CADDS 4 and 4X CAD/CAM systems installed at Navy laboratories under the Computer-Aided Engineering and Documentation System (CAEDOS) Program. This survey was conducted by Computer Resource Technology Corp. (CRTC) in response to requirements of the Computer-Aided Engineering Program (CAEP) Manager, Naval Weapons Center (NWC), China Lake, CA. CRTC performed this task as a subcontractor to Computer Sciences Corp. (CSC) under Subcontract CSC-ATD-85-0-102; NWC, China Lake Delivery Order GM 8J-1, under Prime Contract No. N00123-84-D-0003. This survey was initiated in February 1985. Appendixes A and B are the survey schedules.

This survey was limited to users of the CAEDOS CAD/CAM systems; i.e., the CV CADDS 4 and 4X systems installed at the Navy laboratories in 1982. Data in other CAD/CAM and CAE systems in use at the laboratories were excluded from this survey.

APPROACH

Discussions with several laboratory representatives and experience in conducting previous CAD/CAM productivity surveys led to the conclusion that only limited documentation was available in the laboratories reflecting on productivity as it relates to CAEDOS. Accordingly, it was decided that a questionnaire would be used to obtain individual opinions as to the impact CAEDOS has had on productivity. In using this approach, every effort would be made to identify documentation that may be available to support the productivity improvement

achieved. This approach, in combination with participation by 33% or more of all CAEDOS users and at least 50% of the full-time users, would provide survey results with a high confidence level. The CAEP Manager established specific criteria concerning the nature and structure of the survey, which include the following:

1. No more than 30 minutes would be required by each participant to complete the survey questionnaire.

2. The survey questionnaire would be completed in the presence of the individual conducting the survey.

3. The survey would be structured so that participants could be reasonably expected to answer all questions presented to them (i.e., tailor the questionnaire to specific application areas rather than a single questionnaire covering all application areas).

4. The survey participants would remain anonymous with a questionnaire numbering system established to allow traceability to an individual laboratory.

5. Information on the age, experience in an application area, and experience with CAEDOS would be generated for each participant.

6. The survey would include all application areas where CAEDOS facilities are being used in the laboratories.

7. The survey approach would assume that documentation supporting productivity benefits (negative benefits, if appropriate) would not be available.

8. The basic approach and the survey questionnaire would be approved by the representatives of the various laboratories before starting the survey.

SURVEY STRUCTURE

The structure of the survey is depicted in the survey outline matrix in Appendix C. Participants were requested to complete questionnaires in sections 1.0 and 2.0; a personal profile and satisfaction survey. In addition, participants were requested to select their application area in the survey matrix outline and to complete the questionnaires indicated in these sections. Appendix D is a complete copy of all of the survey questionnaires.

The breakdown of the CAD/CAM/CAE application areas in Appendix C reflects CAEDOS system usage at the laboratories surveyed.

PROFILE OF LABORATORIES SURVEYED

A summary of information pertaining to the CAEDOS system operations at the laboratories is provided in Appendix E. These data are based on a laboratory CAD/CAM/CAE profile obtained at the time each laboratory was surveyed.

In all, there were 577 CAEDOS users, including government and contractor employees, full-, part-time, and intermittent users, at the laboratories surveyed.

Based on the number of users reported in the individual laboratory profiles, summarized in Appendix E, the 191 survey responses received represent 33% of the overall CAEDOS CAD/CAM/CAE user community reported by the laboratories. These same data indicate that 188 workstations, including digitizers, were in use in laboratories at the time of the survey. The majority of workstations are being used on a one shift per workday basis. The exceptions are China Lake, where open shop workstations are being used 2.5 shifts per day, and closed shop workstations 1.25 shifts per day; and Panama City, where open shop workstations are used 1.2 shifts per day.

The data (summarized in Appendix E) also indicate that at least 834 individuals have been trained in the use of CAEDOS since the inception of the program, with 70% of that number listed as current users. That percentage would appear to be an excellent retention level for CAD/CAM/CAE system users.

With the exception of China Lake and Warminster, CAEDOS workstations are managed through a single cost center.

Data reported relative to rates charged for CAEDOS were inconclusive since only five of the 13 sites provided this information. The data provided, however, showed hourly rates varying from $25 to $57 per hour, and annual lease rates ranging from $11,000 to $51,000 per year.

The data requested on the source of funding for CAEDOS at the laboratories were not provided.

SURVEY RESPONSES

PARTICIPATION

In all, 191 individuals from the laboratories participated in the survey. The total number of questionnaire sections completed by the participants from the laboratories is shown in Appendix F. Of a total of 415 questionnaires completed, 55% were for mechanical applications, 35% for electrical, 5% for AEC, and 5% for publications.

Appendix G shows the number of individuals participating by application area or combinations of application areas. Of the total 191 participants, 94, or 49.3%, indicated they used CAEDOS exclusively for mechanical applications; 36, or 18.8% indicated they used the systems exclusively for electrical applications; 12, or 6.3%, for AEC; and three individuals, or 1.6% of the participants, use the systems for publications only. The remaining 24% used CAEDOS for various combinations of application areas.

Of the 191 responses, 15 participants were not hands-on users of CAEDOS but rather were managers or supervisors of the hands-on users. As indicated in Appendix H, and excluding the 15 non-hands-on users, 48% of the full-time, 37% of part-time, and 15% of the intermittent users participated in the survey. Overall, 31% of all laboratory users participated in the survey.

PERSONAL PROFILE OF PARTICIPANTS

The mean age of the survey participants was 33.65 years, with the oldest participant 68 years old and the youngest 19 years old. These data and the number of participants by laboratory with respect to management/supervisor and type of hands-on user are presented in Appendix I.

There appears to be no correlation between prior experience with computers or automated systems and the level of satisfaction with CAEDOS or productivity improvement realized. Over 63% of the survey participants reported extensive or moderate prior experience in using computers, while only 12% reported no experience in using computers prior to the use of CAEDOS.

Ninety-seven, or 51%, of the participants had bachelor degrees. Included in this figure were 21, or 11%, of the participants who hold masters degrees and one with a doctorate. Only eight participants reported no formal education beyond high school. There does not appear to be a clear correlation between educational level and satisfaction with CAEDOS.

SATISFACTION SURVEY

Over 89% of the survey participants felt that CAEDOS had helped them do a better job—3.0 or better on a scale of +7 to −7. Over 50% rated the contribution CAEDOS made to their job performance 5.0 or better on the same scale. Only 21 (11%) participants graded the CAEDOS contribution at 2.0 or less. Appendix J portrays graphically the composite level of satisfaction for all participants at all laboratories and compares this with the level of satisfaction for each laboratory. Although certain laboratories track closely with or exceed the composite level of satisfaction, there are definite areas at some of the laboratories where satisfaction with the CAEDOS system is relatively low. The system's availability, i.e., uptime/downtime because of maintenance problems, was graded low at most laboratories. Similarly, the proficiency achieved through local formal training classes and the extent to which the CAEDOS capability had been integrated into laboratory project planning and scheduling also showed low satisfaction levels. The relative level of satisfaction with CAEDOS at the various laboratories is evident as shown in Appendix J.

OVERALL PRODUCTIVITY IMPROVEMENT

The objective of the survey was to determine the effect CAEDOS has had on productivity at the individual laboratories. Although a number of different questions were asked in each individual application area/section, three key questions in each section were intended to "measure" productivity gains or reductions, if appropriate.

The key questions included in each section are as follows:

1. How much time has been saved (or excess time used) as a result of use of CAEDOS?

2. To what extent has CAEDOS helped you or your organization do a better job?

3. How would you rate the change in quality of work performed as a result of use of CAEDOS?

The responses to these questions are presented graphically in Appendixes K, L, and M.

The responses to the "time saved" question indicate an overall productivity improvement ratio (PIR) of 1.43:1. Similarly, answers to the "help do a better job" question would support a PIR of 2.01:1. Finally, the responses to the quality of work performance questions support a PIR of 2.04:1.

The actual benefit realized as a result of the use of CAEDOS appears to be 1.7:1. Productivity improvement is a function of not only time saved in performing work but also of the quality of work performed. Accordingly, both must be considered when deciding whether CAEDOS has achieved the objectives set forth in the March 1979 final report on the Navy Laboratory Interactive Graphics Study. The 1979 study expresses the PIR only in terms of time saved and projected this benefit to be in the 2.0:1 to 2.6:1 range. This projection included documentation, engineering design, printed circuit board (PCB) design, numerical control (NC) programming, and integrated circuit (IC) design. The use of CAEDOS in the laboratories in the manufacturing NC programming area has been minimal because of the lack of required postprocessors and more important because the laboratories do not have NC programming requirements comparable, for example, to the shipyards. Accordingly, the savings postulated in the NC area have not materialized because of the low level of activity. As a matter of interest, industry users of CAD/CAM report significantly more savings in the CAM area than in the CAD area.

No laboratories reported IC design using CAEDOS. Accordingly, savings in this area have not materialized.

Based on the foregoing considerations, it would appear that an average FIR of 1.7:1 (averaging 1.42:1 and 2.04:1, to reflect both a quantitative and qualitative measure) comes close to achieving the original objectives projected in the March 1979 final report of the Navy Laboratory Interactive Graphics Study.

MECHANICAL AND ELECTRICAL CAD, NEW DESIGN VERSUS CHANGES

The following table summarizes the number of jobs worked involving new design versus changes for mechanical and electrical CAD.

	Average number of jobs completed annually per user—all laboratories	
	Design	Drafting/Detailing
Mechanical		
New design	16	30
Changes	13	29
Electrical schematic		
New design	8	19
Changes	5	31
Electrical PCB		
New design	11	12
Changes	12	13

The information provided on the number of jobs performed varied widely, which indicates a basic problem in the definition of a job. Where the number of jobs reported exceeded 400 per year, these data were eliminated from the survey (number of jobs reported were as high as 2000 per year). Even with these adjustments, the wide range of data provided render the data unsuitable for quantitative calculation.

The data obtained through the survey permits an approximation of the ratio between new design activity and changes to existing designs. Based on the data provided, it appears that in the mechanical and electrical printed circuit board design and drafting/detailing areas, the number of initial design jobs and changes is approximately equal. In the electrical schematic area, however, the number of initial designs is approximately two times the number of changes, while in the detailing and drafting area change activity is approximately 1.8 times the initial design effort.

The data provided through the survey on time to complete electrical jobs are summarized as follows:

	Small jobs, days	Large jobs, days
Electrical schematic		
Design	2.7	8.3
Detailing	1.8	5.3
PCBs		
Design	5.1	17.1
Detailing	5.2	16.6

Although these data are not absolute because of the problem mentioned earlier relative to the definition of a job, they do provide a comparison between design and detailing as well as a comparison between the average time to complete electrical schematic and PCB jobs. The data, however, are not suitable for quantitative analysis of productivity improvement attributable to use of CAEDOS.

2-D VERSUS 3-D CAPABILITY

The survey participants were asked to state the percentage of their work that required a three-dimensional capability versus the percentage that could have been satisfied by a two-dimensional capability. The following table summarizes the responses received:

	Percent of work requiring 3-D		Percent of work satisfied by 2-D	
	Mean, %	Std. dev., %	Mean, %	Std. dev., %
Mechanical design				
All laboratories	58	35	39	35
Annapolis	93	8	19	34
China Lake	60	37	34	38
Carderock	83	18	20	19

	Percent of work requiring 3-D		Percent of work satisfied by 2-D	
	Mean, %	Std. dev., %	Mean, %	Std. dev., %
Mechanical design (Contd.)				
Dahlgren	45	32	51	32
New London	39	33	53	36
Newport	69	32	30	32
Panama City	82	27	26	33
San Diego	42	26	47	30
Warminster	63	40	17	15
White Oak	41	36	56	38
Detailing and drafting				
All laboratories	41	35	53	37
Annapolis	78	27	38	40
China Lake	42	34	52	37
Carderock	83	18	20	19
Dahlgren	34	22	50	31
New London	33	34	58	41
Newport	87	23	10	17
Orlando	4	8	96	8
Panama City	38	43	62	43
San Diego	43	34	50	32
Warminster	63	40	23	15
While Oak	24	24	65	37

The above data are clearly not a consensus favoring 3-D or 2-D for design work or for drafting. With the exception of several laboratories, i.e., Annapolis and Carderock, the relatively large standard deviations would indicate a wide variation in opinion regarding the requirement for a 3-D capability. Although the overall results favor 3-D for design and 2-D for drafting, both by small margins, the more important conclusions that can be drawn from these results are that

1. Most participants have had minimal experience in working with a 3-D model in mechanical design.

2. There is a possible need for training in mechanical design work.

3. There is a possibility that a large percentage of the participants responded from the point of view of drafting or detailing rather than engineering design.

RELATIVE DESIGN COMPLEXITY

It was expected that the design, drafting, and NC programming work being performed using CAEDOS would be significantly more complex than similar work performed manually. The following tabulation of the survey results indicate that the perceived or reported increase in complexity is minimal.

Application	Increase in complexity, %
Mechanical	
Design	13
Analysis	11
Drafting	10
Manufacturing	23
Schematic	
Design	17
Analysis	13
Drafting	13
PCB	
Design	17
Analysis	14
Drafting	20
Manufacturing	−4
All areas	9

Approximately 50% of the participants who responded to this question indicated a 0% change. The majority of those who did respond with a value other than 0% assigned increased complexity values in the 30 to 60% range. Several respondees indicated that the work being performed on CAEDOS was less complex than that performed manually.

Individuals at the laboratories during the survey indicated a problem with judging the relative complexity; i.e., when is a part 50% more complex or 90% more complex? Because of the problem with judging complexity, many respondents assigned a 0% value rather than hazard a guess on the actual change in complexity. Those individuals with whom discussions were held did indicate that CAEDOS did facilitate more complex design work than was previously possible.

Accordingly, survey results suggest that more complex work is being performed on CAEDOS, but the degree of increased complexity could not be approximated.

SURVEY COMMENTS

GENERAL COMMENTS

The survey participants made extensive comments in completing the questionnaires. These comments provide supplemental information and rationale for some of the values assigned in the questionnaires. The comments also afforded the users the opportunity to express their opinions concerning CAEDOS improvements or changes needed to help them do a better job. Appendix N lists these comments and their frequency of occurrence. Appendix O lists the individual comments by laboratory of origin, sections applicable, and number of occurrences.

In all, 707 comments were made on the questionnaires. Eight subjects accounted for the majority of these comments as follows:

Comment	Frequency
Require additional or improved applications software packages	205
Require additional, more advanced, or improved training	135
Require improved CAEDOS operating systems or utility software	105
Require improved management support for CAEDOS	87
System maintenance support, system uptime, CV field service response for hardware, and software problems	93
CV system is unfriendly	28
Need additional workstations or additional system capacity	22
Other comments	32

NEED FOR ADDITIONAL APPLICATIONS SOFTWARE

Of the total of 205 comments, 76 stated a general need for improved applications software without mention of a specific package or application area. The following tabulation represents the most frequently mentioned application area requirements:

Comment	Frequency
Finite element modeling and analysis (FEM/FEA)	36
Parts libraries	19
Solids modeling	17
NC pre- and postprocessor	7
Hidden line removal	7
Improved PCB routing	6

The most frequently mentioned FEM/FEA packages were ABAQUS, SDRC, and PATRAN G. Both in the comments on the questionnaires and in conversations with users, the need for an interface between the CAEDOS and the VAX and larger mainframes was stated many times. Most individuals felt that the more capable FEA software required more capacity than was available in the CAEDOS, but that CAEDOS could accommodate the appropriate FEM software and a postprocessor to prepare results of the analysis for display on CAEDOS.

The parts library comment dealt mostly with architectural parts libraries and, to a lesser extent, electrical schematic and PCB components. There were no requirements stated for mechanical component libraries.

The software packages mentioned in the comments but not listed above covered a wide range from text fonts to advanced surface design. Review of Appendix N indicates these less frequently mentioned packages.

TRAINING

The need for additional training was the second most frequent specific comment, 135 such comments out of 707 overall comments. The expressed need for additional training extended across all application areas. The underlying needs being expressed were as follows:

More training
Advanced training
Training availability or scheduling
More qualified instructors
Training in a specific capability (i.e., modeling and FEM)
Training in new releases

In the satisfaction survey, the participants expressed general satisfaction with the CAEDOS training program rating vendor training somewhat higher than formal in-house training. Training that has been provided is satisfactory, but there is not enough training; advanced training is required, training in specific subjects is required, or training scheduling problems exist (when a person can attend or when he does need training versus when a course is available).

Most individuals who mentioned that the CV system is unfriendly also mentioned the need for training. The "unfriendly—hard to learn" comment was made 28 times.

CAEDOS SYSTEM SOFTWARE, UTILITIES, AND SOFTWARE REVISIONS

The following comments refer to CAEDOS system software, utilities, and software revisions.

Comment	Frequency
CV software and revisions contain many "bugs" and require too much time to fix	49
Upgrade to CADDS 4X is required	17
Require capability to write Fortran programs to extend CV system capabilities	12

Comment	Frequency
CV's error messages are misleading, inaccurate, and not always helpful—resolution takes too long	11
Require facility to provide immediate notification of an input error	6
Others	10
Total	105

The relative instability of the CV software, particularly new releases, was mentioned very frequently by the system managers and various users. There was a definite feeling that CADDS 4X is much more stable than CADDS 4. However, CV did not maintain 100% upward compatibility between 4 and 4X, a source of considerable dissatisfaction at several laboratories.

CAEDOS SYSTEM MANAGEMENT

The major opinion expressed in CAEDOS system management was that support for CV system users requires improvement. The remainder of the comments in this area appeared to be a subset of the major comment and dealt with poorly written technical manuals, use of CAEDOS as a drafting system rather than an engineering design system, dissatisfaction with the system configuration, and insufficient time for new application development at the laboratory.

The major comment made by the system managers was that the system manager had to be (1) expert in operation of the CAEDOS system and its capabilities; (2) knowledgeable in the applications area in use at a particular laboratory; and (3) conversant with procedures for managing and acquiring facilities, software, and new equipment. Most of the system managers were aware of the requirements and the application areas in which their systems were being used. It is obviously impossible for the system managers to be fully knowledgeable in all the management processes and procedures, the operating systems and utility software, and in the nuances of the various application areas.

One highly qualified individual for each application area should be designated to specify requirements, define needed interfaces, and train and oversee the system's use in that particular area at each laboratory. The system manager should be required to deal with these individuals and respond to their requirements rather than have to arbitrate between several application area specialists.

SYSTEM MAINTENANCE AND OPERATION

The major comment in system maintenance and operation was that the system was too slow either because of high disk storage use and too many workstations, or for unspecified reasons. Of the 93 comments under this heading, 50 dealt with slow system response time. Comments on slow system response time were made by most laboratories and in all application areas.

In discussions with users at the various laboratories, a frequently made comment was that the parts libraries being used occupied too much disk space. In many cases, libraries occupied up to 25% of one drive. The number of parts libraries loaded was not specified; however, this would certainly cause a slow down as a workday progressed and as data stored on a disk drive approached the drives practical capacity.

Apart from the component library/disk drive situation, most users stated in their verbal comments that one CPU could handle three workstations with acceptable degradation in response time. Similarly, most felt that any more than three drives in use at the same time led to an unacceptable response time.

One laboratory was high in its praise of the CV field engineer (FE) and systems engineer (SE) support personnel, while most other laboratories felt that CV was not sufficiently responsive to system maintenance problems. Comments were made indicating FEs and SEs required more training, required more support from CV, or carried defective replacement modules. Several laboratories stated that they required an on-site engineer.

CONCLUSIONS AND RECOMMENDATIONS

CAEDOS has resulted in definite productivity benefits at the Navy laboratories surveyed. These benefits have been realized primarily in the mechanical and electrical engineering design and the drafting and detailing application areas.

CAEDOS is being used primarily as a drafting tool and, to a far lesser extent, as an engineering design tool.

CAEDOS has been used only minimally in the computer-aided engineering and analysis area, because of the nonavailability of CAE and analytical tools on the system and the lack of communications between CAEDOS and larger computers, which use CAE and analysis tools.

The NC programming capability of CAEDOS has not produced projected productivity benefits because of the lack of postprocessors for specific machine tools. The CAEDOS NC capability appears to be underused at all of the laboratories.

Although most users participating in the survey expressed a relatively high level of satisfaction with vendor training, they were less satisfied with in-house training and indicated a need for advanced training in all application areas. There also appears to be a scheduling problem with respect to individual users being able to take advantage of training sessions because of their work schedules.

The CAEDOS management function at certain laboratories is not structured to ensure maximum support for the users. Managers spend much of their time on administrative duties and in dealing with CAEDOS operating matters. They are not always qualified in the application areas and the related software packages.

Users at most laboratories are dissatisfied with CAEDOS availability and maintenance support for hardware and software of all types.

It appears that the CAEDOS design, analysis, and documentation capabilities have not been integrated into the laboratories' project managment, planning, and scheduling. In a related matter, laboratory upper management does not place performance demands on CAEDOS because of uncertainty concerning the system's reliability (availability) and lack of a clear understanding of the system's capabilities.

CAEDOS lacks communication interfaces with larger mainframes offering extended analysis capabilities and smaller stand-alone workstations designed for specialized types of design and analysis jobs. The availability of these interfaces would extend the effective economic life of CAEDOS significantly.

Based on the foregoing conclusions, the following recommendations are made:

1. Accelerate training in the use of 3-D modeling for engineers and designers. Promote use of CAEDOS as an engineering design facility to develop models of parts, components, or systems with such models being used to support all "downstream" functions.

2. Define the CAE and analysis requirements at each laboratory in terms of specific capabilities and available off-the-shelf software packages that will satisfy these requirements. Determine which software packages can be supported by CAEDOS, with the necessary programming or interfaces to other systems, and those that cannot be supported by CAEDOS under any circumstances. Initiate projects to develop required CAEDOS CAE programs and to develop non-CAEDOS solutions where CAEDOS cannot be used.

3. Define NC postprocessors required to support all NC machine tools at the laboratories. Initiate a vigorous program to either acquire such postprocessors, develop them locally or, if this is not feasible, evolve a "work-around" solution to make maximum use of the CAEDOS NC capability.

4. Provide training in advanced subjects to go beyond existent vendor or in-house training. Offer such training on schedules that are convenient to the trainee rather than to the instructors. Designate CAD/CAM/CAE training specialists to help individuals get the most out of CAEDOS.

5. Restructure the CAEDOS management functions at the laboratories to recognize the need for management and direction in the application areas as well as system utilization.

6. Improve system availability by improving system maintenance and response to both hardware and software problems.

7. Establish a program to educate laboratory top management in the benefits of effective use of CAD/CAM and CAE at the laboratories.

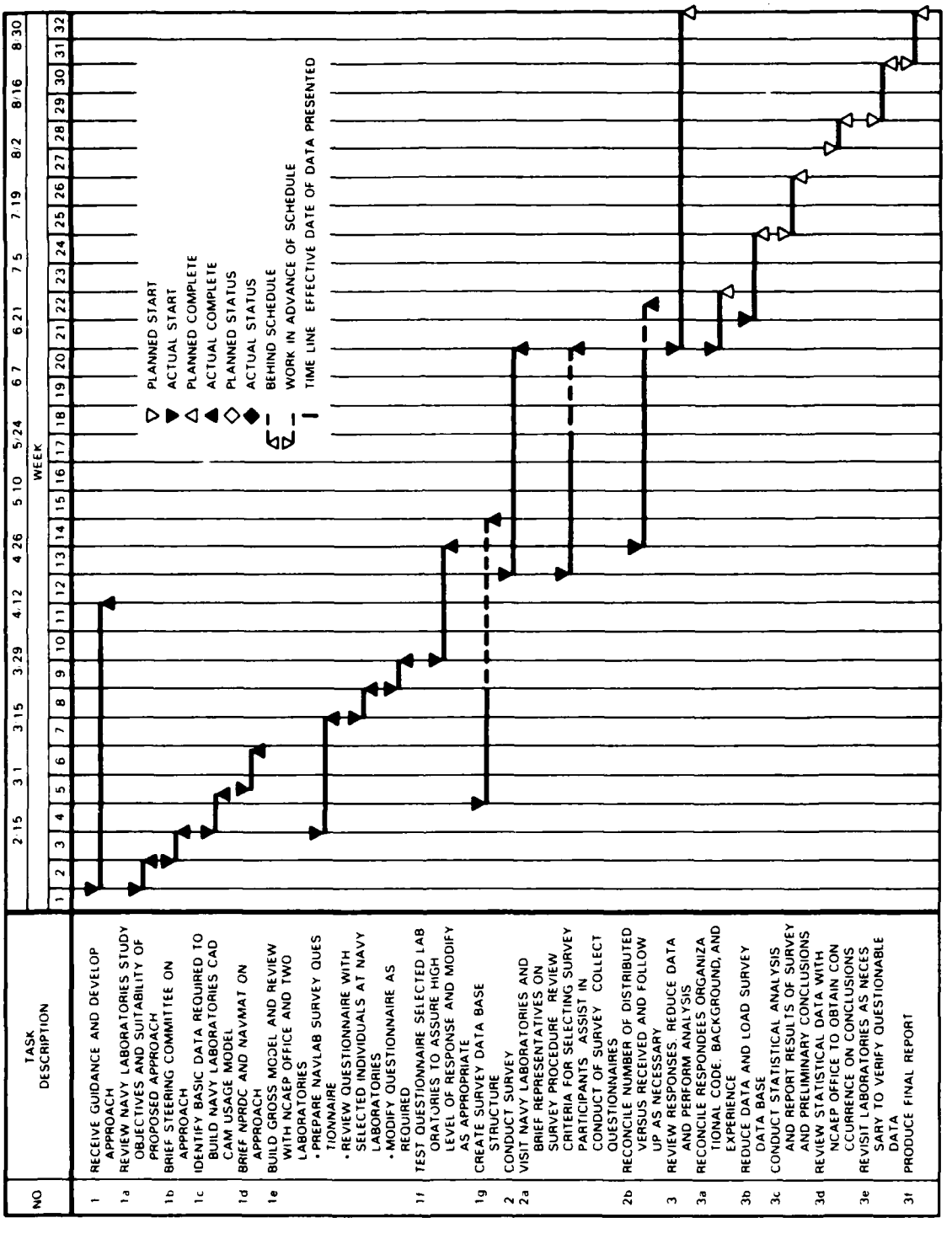
8. Procure or develop internal communication interfaces between CAEDOS and the large mainframes at the various laboratories and between CAEDOS and the smaller stand-alone CAE workstations.

Appendix A

CAD/CAM PRODUCTIVITY SURVEY
NAVMAT RESEARCH AND DEVELOPMENT CENTERS
ACTIVITY PLAN AND SCHEDULE

CAD/CAM PRODUCTIVITY SURVEY

NAVMAT RESEARCH AND DEVELOPMENT CENTERS ACTIVITY PLAN AND SCHEDULE



Appendix B

NAVY LABORATORY CAD/CAM PRODUCTIVITY SURVEY

Tentative Survey Schedule

NAVY LABORATORY CAD/CAM PRODUCTIVITY SURVEY

Tentative Survey Schedule

Laboratory	Date	Time	
		First meeting	Second meeting
NUSC Newport	May 20	0900	1330
NUSC New London	May 21	0900	1330
NADC Warminster	May 22	0900	1330
DTNSRDC Bethesda	May 23	0800	0930
NSWC White Oak	May 23	0830	1000
DTNSRDC Annapolis	May 23	1330	1430
NSWC Dahlgren	May 24	0830	1300
NTEC Orlando	June 3	0900	1300
NCSC Panama City	June 4	0900	1300
NOSC San Diego	June 6	0900	1300
NWC China Lake	June 11	0900	1300
NOSC Malakipa, HI	June 13	0900	1300

Appendix C

NAVY LABORATORY CAD/CAM/CAE SURVEY OUTLINE

NAVY LABORATORY CAD/CAM/CAE
SURVEY OUTLINE

			Application Areas					
		0	1	2	3	4	5	6
		General	Design	Analysis	Drafting/ Detailing	Mfg'ing, Num.Control	Robotics	Graphics Arts
1	Personal	1.0						
2	Satisfaction	2.0						
3	Mechanical		3.1	3.2	3.3	3.4	3.5	
4	Electronic Schematic		4.1	4.2	4.3			
5	Electronic PCB Layout		5.1	5.2	5.3	5.4		
6	Architectural & Engineering Construction		6.1(2)	6.2(2)	6.3(2)			6.6(2)
7	Publications				7.3			7.6

Note: (1) Each survey participant is requested to answer all the general questions in sections 1.0 and 2.0. In addition, each participant is requested to answer all the questions in those survey sections that relate to his/her current job or application area. Any questions regarding the set of survey questions to be answered should be addressed to your laboratory survey coordinator.

(2) These sections have been consolidated into one set of survey questions. Respondee is requested to indicate in section 1.0, question 10, the application areas that describes his/her present job or duties.

Appendix D

NAVY LABORATORY CAD/CAM/CAE SURVEY QUESTIONNAIRES

LABORATORY PROFILE

1. Name:

2. Site:

3. Mission:

4. CAD/CAM/CAE Application Areas (See matrix)

_____ _____ _____

_____ _____ _____

5. Number of CAD/CAM/CAE Workstations

	(1) Number	(2) Average Shifts
a) Closed Shop	_____	_____
b) Open Shop	_____	_____
c) Dedicated	_____	_____
TOTAL	_____	

6. Number of Users:

A) Type User (operator)	Military/Civilian	Contractors
1) Full Time user	_____	_____
2) Part Time user	_____	_____
3) Intermittent user	_____	_____
B) Number of employees who have received *formal* training (including vendor, other off-site, or local on-site formal training or instruction) (Exclude cassette training)	_____	_____

7. Local Networks For Communicating Various Types of Geometric, Graphic and Design Data.

Communications Facilities	Bandwidth	Number of Nodes
1) _____	_____	_____
2) _____	_____	_____
3) _____	_____	_____

8. Method Of Funding CV CAD/CAM/CAE Services.

a) Is the CV CAD/CAM/CAE System controlled for budget purposes under one cost center? (Yes/No) |_____|

- If Yes, please provide the following information:

o Percentage of cost center budget funded by laboratory overhead. |_____%|

o Percentage of cost center budget funded by direct project work. |_____%|

o Percentage of cost center budget funded by project work charged to departmental or program overhead budget. |_____%|

b) If CV CAD/CAM/CAE services are provided on an "Open" and "Closed" shop basis, (see definition below) please complete the following matrix.

METHOD OF FUNDING CV CAEDOS SERVICES

Shop, Site or Location	Type Shop		Number Of Work Stations				How are Charges Levied; by plots, hourly usage, storage, plotter output, etc.	Cost Per Charge Unit
	Open (O)	Closed (C)		Overhead Subsidy %	Direct Project %	Overhead Project %		
# 1								
# 2								
# 3								
# 4								
# 5								
# 6								

(NOTE) In an "Open" shop, work stations are available to any or all customer-users who either operate the system themselves or provide an average for operators. In a "closed" shop the shop provides operators who perform work to satisfy customer needs. A facility can be a closed shop and yet make work station time available to customer users on an open shop basis. Dedicated systems, i.e. those assigned for the exclusive use of program or departmental organization can be either closed or open shop, depending on how the project or department funds the facility. If the facility is treated totally as a project or departmental overhead item, it should be described under question 8a above.

00113

This is your
Questionnaire Number

NAVY LABORATORY

CAD/CAM SURVEY QUESTIONNAIRE

COVER SHEET

Instructions

(1) Select your application area or areas by referring to the section numbers indicated on the attached survey outline.

(2) Obtain survey questionnaire sections for your application area(s) from your laboratory survey coordinator.

(3) Make sure the pre-stamped questionnaire number above matches the pre-stamped number on Sections 1.0 and 2.0 attached to this cover sheet. Also, PRINT THIS NUMBER ON EACH PAGE OF THE APPLICATION AREA SECTIONS YOU ARE ABOUT TO COMPLETE.

(4) Please COMPLETE ALL QUESTIONS in Sections 1.0 and 2.0 and also in the application area sections you have selected.

(5) Unless otherwise indicated, the questions in this survey refer to your experience with the Computervision CAEDOS System.

(6) In this questionnaire, where a percentage answer is requested, a 50% increase will be interpreted as doing half again as much work. In the same context a 100% increase will be interpreted as a doubling of the previous level.

(7) Return the completed survey questionnaire to your laboratory survey coordinator.

NAVY LABORATORY
CAD/CAM/CAE
SURVEY OUTLINE (1)
(Numbers below refer specifically to a General or Application Area section of the survey)

			Application Areas					
		0	1	2	3	4	5	6
		General	Design	Analysis	Drafting/ Detailing	Mfg'ing, Num.Control	Robotics	Graphics Arts
1	Personal	1.0						
2	Satisfaction	2.0						
3	Mechanical		3.1	3.2	3.3	3.4	3.5	
4	Electronic Schematic		4.1	4.2	4.3			
5	Electronic PCB Layout		5.1	5.2	5.3	5.4		
6	Architectural & Engineering Construction		6.1(2)	6.2(2)	6.3(2)			6.6(2)
7	Publications				7.3			7.6

Note: (1) Each survey participant is requested to answer all the general questions in sections 1.0 and 2.0. In addition, each participant is requested to answer all the questions in those survey sections that relate to his/her current job or application area. Any questions regarding the set of survey questions to be answered should be addressed to your laboratory survey coordinator.

(2) These sections have been consolidated into one set of survey questions. Respondee is requested to indicate in section 1.0, question 10, the application areas that describes his/her present job or duties.

0118
Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

1.0 PERSONAL PROFILE

1. Laboratory (CL, SD, PC, WO, DL, CR, AN, NL, NP, OR, WM) --------

2. Organization Code --------
   (branch level or equivalent)

3. Are you a manager/supervisor? (Yes or No) --------

4. Are you a hands-on CAD/CAM/CAE user. (Yes or No) --------
   (If No, skip question 5)

5. To what extent do you use CAD/CAM/CAE?

   - Full Time (hrs/day) --------
   - Part Time (hrs/week) --------
   - Intermittent (hrs/mo) --------

6. What has been your exposure to or experience in computer technology other than the CV System?
   (E Extensive - Full time; M Moderate - One year or more, part time; L Limited - Less than one year, part time; N No experience or exposure)

   - Write computer programs --------
   - Use canned programs to solve problems --------
     (i.e. spread sheet, NASTRAN, etc)
   - Experience on other CAD/CAM/CAE Systems --------
   - Use personal computers or office terminal --------
   - Use personal computers at home --------
   - Manage or supervise functions that use computers --------
   - Other (Describe) _____ --------
     _____
     _____

7. Age --------

8. Educational Background (Years)

   - High school --------
   - Apprentice Program --------
   - Technical School --------
   - College --------
   - Graduate school --------
   - Other _____ --------

C0113
Questionnaire I

		Award	Major
9.	What diplomas, degrees or certificates have you been awarded and what were your major areas of study?	--------	--------
		--------	--------

		Section #
10.	What application areas are you working with now? (Indicate the appropriate section number from the matrix)	_____
		_____
		_____
		_____
		_____
11.	What application areas have you been associated with over the past 10 years? (Refer to matrix)	_____
		_____
		_____
		_____
		_____

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

2.0 SATISFACTION SURVEY

Please indicate your level of satisfaction by assigning a plus (+) or positive value from +7 to +1 where you are satisfied; +7 where you are highly satisfied through +1 where you are barely satisfied. If you are dissatisfied, assign a value of -1 through -7; -1 where you are minimally dissatisfied through -7 where you are very dissatisfied.

1. How well do the CV System capabilities meet the requirements of your current application area? |_____|

2. To what extent has the CV System helped you do a better job? |_____|

3. To what extent has the CV System assisted you in improving the quality of work accomplished? |_____|

4. To what extend were you able to enroll yourself (your employees) in the training courses needed for your application area? |_____|

5. How would you rate the formal training courses you (your employees) have attended with respect to the

	CV (Vendor)	In-House
a) Quality of Instruction	|_____|	|_____|
b) Course Content	|_____|	|_____|
c) Subject Matter Rentention	|_____|	|_____|
d) Level of Proficiency Achieved	|_____|	|_____|

6. How satisfied are you (your employees) with your (their) ability to use the system? |_____|

7. To what extent is system time that is available to you (your employees) sufficient to meet your job requirements or the needs of your organization? |_____|

8. How would you rate the system's operational availability? (i.e. System up time vs down time due to hardware or software failure or maintenance) |_____|

00113

Questionnaire I

9. How satisfied are you (your employees) with the impact the CV System has had on productivity in your area? |_____|

10. To what extent has the capability and capacity of the CAD/CAM/CAE system been integrated into research and development planning and scheduling at your laboratory? (i.e. In setting schedules, do program managers plan on using system capabilities?) |_____|

11. To what extent is the capacity of the system adequate to meet your organization's needs? |_____|

COMMENTS:

After completion of Sections 1.0 and 2.0, if you have not already done so, please obtain survey application area sections relating to your present position or function from your laboratory survey coordinator.

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 3.1 MECHANICAL DESIGN

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire F

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

3.1 MECHANICAL DESIGN

1. How much experience do you have in mechanical design? | Yrs | Mos |

2. How much experience do you have with mechanical design using the CV System? | Yrs | Mos |

3. Approximately how many mechanical designs have you (or your employees) worked on during the past 12 months using the CV System? |

   o How many were new designs? |

   o How many were design changes (including changes to the above new designs? |

4. To what extent does use of the CV System save time or take more (add) time to accomplish mechanical design tasks compared to manual methods for:

	Saves Time	Adds Time
o simple individual mechanical parts (i.e. piston, shaft, housing, casing section, bracket, etc.)?	% / No Change	%
o mechanical assemblies or complex components (i.e. actuator, value, flight control mechanisms, impeller, etc.)?	% / No Change	%
o an overall system or subsystem (i.e. missile, missile launcher, weapon system, etc.)?	% / No Change	%

5. What percentage of the designs referred to in questions 3 and 4 above:

   o required a 3 dimensional modeling capability (finite element modeling, mass properties analyses, 3D NC, interference checking, visualization, etc.)? |%|

   o could have been satisfied with a 2 dimensional capability (drafting, stamping, 2D NC, nesting, area layout, etc.)? |%|

Questionnaire #

6. How would you rate the changes in the quality of mechanical designs that are attributable to the use of the CV System?

Significant Improvement							No Change							Significant Degradation
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. How much more or less complex are mechanical designs now being developed on the CV System compared with the designs developed manually?

Less Complex	More Complex
- %	+ %
No Change	

8. To what extent has the CV System helped you (your employees) do a better job of mechanical designs?

Very Beneficial							No Change							Hampers Performance
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

9. What value would you assign to the use of the CV System's modeling capability?

Very Beneficial							No Change							Degrades Design
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

10. What value would you assign to the use of the CV System's simulation capability? (Initial design concept comparisons, geometric comparisons, interference analysis, etc.).

High Value							No Change							Degrades Design
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

11. To what extent has mechanical design productivity increased (Incr) or decreased (Decr) as a result of use of the CV System analytical capabilities?

Productivity (Incr)	(Decr)
+ %	- %
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

Questionnaire #

12. To what extent has the CV System permitted the use of earlier designs to produce new mechanical designs?

Great Extent							No Help							Wastes Time
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

13. To what extent has the CV System expedited the process of making design decisions?

Considerable Help							No Help							Delays Decisions
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

14. What do you need or what would it take in expanded CV System capabilities to do the job of mechanical design better, e.g. training, software packages, output devices, etc?

_____
_____
_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 3.2 COMPUTER-AIDED MECHANICAL ENGINEERING ANALYSIS

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire I

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

3.2 COMPUTER-AIDED MECHANICAL ENGINEERING ANALYSIS

1. How much experience do you have in:

• Mechanical Analysis?	|__|Yrs| |Mos|
• Finite Element Analysis?	|__|Yrs| |Mos|
• Structural Dynamics?	|__|Yrs| |Mos|
• Fluid Dynamics?	|__|Yrs| |Mos|
• Heat Transfer?	|__|Yrs| |Mos|
• Other? _____	|__|Yrs| |Mos|

2. What is your CAE experience with:

• CV?	|__|Yrs| |Mos|	PATRAN G?	|__|Yrs| |Mos|
• IBM?	|__|Yrs| |Mos|	MSC NASTRANS?	|__|Yrs| |Mos|
• CDC?	|__|Yrs| |Mos|	COSMIC?	|__|Yrs| |Mos|
• Prime?	|__|Yrs| |Mos|	STRUDL?	|__|Yrs| |Mos|
• VAX?	|__|Yrs| |Mos|	SDRC?	|__|Yrs| |Mos|
• Cray?	|__|Yrs| |Mos|	ABAQUS?	|__|Yrs| |Mos|
• Other? _____	|__|Yrs| |Mos|	Other? _____	|__|Yrs| |Mos|

	Saves Time	Adds Time
3. To what extent does the CV System save time or take more (add) time to complete mechanical analyses?	|_____%| |_____%|	
	|No Change|	
• Is data available to substantiate the above?	|__|Yes| |No|	
	|__|Don't Know|	

Questionnaire #

4. How would you rate the changes in the quality of mechanical analyses that are attributable to the use of the CV System?

Significant Improvement No Change Significant Degradation

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

5. How much more or less complex are mechanical analyses now being developed on the CV System compared with the analyses accomplished manually?

Less More Complex

- %	+ %
No Change	

6. To what extent has the CV System helped you (your employees) do a better job of mechanical analysis?

Considerable Help No Help Degrades Performance

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. What do you need or what would it take in expanded CV System capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____

_____

_____

COMMENTS:

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

Question 8 - Are the CAE capabilities listed below and related post processors now available to you at your laboratory?

Computer-Aided Engineering Capability	CAE Capabilities			Post Processor		
	Now Available On CV System (Yes/No)	Now Available On Other Local System (Yes/No)	Available Through Time Sharing Service (Yes/No)	Now Available On CV System (Yes/No)	Now Available On Other Local System (Yes/No)	Not Available (N/A)
a) Mass Properties Analysis (MPA) (1)						
b) Finite Element Modeling (FEM) (1)						
c) Finite Element Analysis (FEA) (1)						
d) Heat Transfer Analysis (HTA) (1)						
e) Kenamatic Analysis (KA)						

(1) Please indicate the following in the spaces provided below:

a) Trade name of the specific software packages now available (N), you plan (P) to install, or wish (W) to install, on the CV System for each CAE capability; MPA _____ _____, FEM _____ _____, FEA _____ _____, HTA _____ _____, KA _____ _____.

b) Trade name of the specific software packages now available (N), you plan (P) to install, or wish (W) to install, on local systems other than the CV System for each of the above capabilities; MPA _____ _____, FEM _____ _____, FEA _____ _____, HTA _____ _____, KA _____ _____.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

Question 9 - To what extent has the quality of design benefited as a result of having the CAE capabilities available? (10 - High Quality Benefit; 0 - No Quality Benefit)

Computer-Aided Engineering Capability	Benefit If Available On CV System	Benefit If Available On Other Local System	Benefit If Available On Remote Time Sharing System
a) Mass Properties Analysis (MPA)			
b) Finite Element Modeling (FEM)			
c) Finite Element Analysis (FEA)			
d) Solids Modeling (SM)			
e) Heat Transfer Analysis (HTA)			
f) Kenamatic Analysis (KA)			

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 3.3 MECHANICAL DRAFTING/DETAILING

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire F

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

3.3 MECHANICAL DRAFTING/DETAILING

1. How much experience do you have in mechanical drafting/detailing? | Yrs | Mos |

2. How much experience do you have with mechanical drafting/detailing using the CV System? | Yrs | Mos |

3. Approximately how many mechanical drawings have you prepared or worked on during the past 12 months using the CV System? |_____|

   o How many were new drawings? |_____|

   o How many were changes to drawings resident on the System (including above new drawings)? |_____|

4. To what extent does use of the CV System save time or take more (add) time to complete mechanical drawings compared to manual drawing methods for:

	Saves Time	Adds Time
o simple individual mechanical parts or components (i.e. piston, shaft, housing, casing section, bracket, etc.)?	%	%
	No Change	
o mechanical assemblies or complex components (i.e. actuator, value, flight control mechanisms impeller, etc.)?	%	%
	No Change	
o an overall system or subsystem (i.e. missile, missile launcher, weapon system, etc.)?	%	%
	No Change	

5. What percentage of the drawings referred to in questions 3 and 4 above:

   o required a 3 dimensional modeling capability (interference checking, visualization, etc.)? |_____%|

   o could have been satisfied with a 2 dimensional capability (drafting, stamping, nesting, area layout, etc.)? |_____%|

Questionnaire 1

6. How would you rate the changes in the quality of mechanical drafting/detailing that are attributable to the use of the CV System?

High Benefit							No Change							Degrades Quality
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. How much more or less complex are mechanical drafting/detailing jobs now being processed on the CV System compared with the those accomplished manually?

Less Complex	More Complex
- %	+ %
No Change	

8. To what extent has the CV System helped you (your employees) do a better job of mechanical drafting/detailing?

Very Beneficial							No Change							Degrades Performance
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

9. To what extent has the CV System permitted the use of earlier drawings to produce new detailed drawings?

High Frequency							No Help							Wastes Time
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

- Is data available to substantiate the above?

Yes	No
Don't Know	

10. Do you use the CV System to prepare Bills of Material?

Yes	No

- If the answer is "Yes", does the CV System save time or take more (add) time to prepare Bills of Material?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

Questionnaire F

11. What value would you assign to a mechanical parts component library installed on the CV System for use in completing mechanical drawings?

Very Valuable — No Value — Reduces Production

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

12. If the value assigned in question 11 is plus five (+5) or more, what savings in time to complete a mechanical drawing would you attribute to use of a component library? | ____ % |

* Is data available to substantiate the type of savings indicated in question 11 above?

Yes	No
Don't Know	

13. What do you need or what would it take in expanded CV System capabilities to do the job of drafting/detailing better (e.g. training, software packages, output devices, etc)?

_____

_____

_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 3.4 MECHANICAL NUMERICAL CONTROL

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

3.4 MECHANICAL NUMERICAL CONTROL

1. How much experience do you have in mechanical numerical control (NC)?

Yrs	Mos

2. How much experience do you have with mechanical NC using the CV System?

Yrs	Mos

3. To what extent does the utilization of the CV System save time or take more (add) time to complete fabrication of the mechanical parts?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

4. How would you rate the changes in the quality of finished parts that are attributable to the use of the CV System?

Highly Improved — No Improvement — Degrades Quality

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

5. How much more or less complex are the parts now being fabricated using the CV System compared with the manually programmed parts?

Less Complex	More Complex
- %	+ %
No Change	

6. To what extent has the CV System helped you (your employees) do a better job of NC programming?

Considerable Help — No Help — Degrades Performance

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

Questionnaire I

7. The following questions relate to the use of design engineering databases to fabricate mechanical parts rather than manufacturing them manually.

   * Do you use engineering design databases to create NC programs that are used to fabricate mechanical NC parts? | Yes | No |

   * If the above answer is "Yes", what value would you assign to the quality and accuracy of design engineering databases with respect to their adequacy for development of NC programs?

   Highly Outstanding **No Opinion** **Grossly Inadequate**

   | +7 | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 |

   * What productivity benefit would you assign to the use of design engineering databases to develop NC programs used to fabricate mechanical parts versus having to create the part geometry from drawings?

	Saves Time	Adds Time
	%	%
	No Change	

   * Is data available to substantiate the above? | Yes | No | Don't Know |

   * Are engineering design drafting and detailing standards adequate at your activity to support development of NC programs from design engineering databases? | Yes | No |

8. What aggregate productivity benefit (savings in time, accuracy, etc) do you realize or would you expect to realize through the use of applicable post processors installed on the CV System?

	Saves Time	Adds Time
	%	%
	No Change	

Questionnaire #

9. Please indicate whether or not you (your employees) have used the following capabilities on the CV System in connection with development of NC programs. If "Yes", indicate the productivity benefit achieved, if any, and whether or not data is available to substantiate the benefit.

	Have used capability	Productivity Benefit	Data Available
• Surfaces	Yes / No	+ % / - % / No Change	Yes / No
• Multi Axis Programming	Yes / No	+ % / - % / No Change	Yes / No
• Nesting	Yes / No	+ % / - % / No Change	Yes / No
• Flat Pattern Generation	Yes / No	+ % / - % / No Change	Yes / No
• Tool & Fixture Library	Yes / No	+ % / - % / No Change	Yes / No

10. What do you need or what would it take in expanded CV System capabilities to do your job in NC programming better (e.g. training, software packages, post processors, communications, etc.)?

_____
_____
_____

COMMENTS:

Questionnaire Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 3.5 MECHANICAL ROBOTICS

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire T

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

3.5 MECHANICAL ROBOTICS

1. How much experience do you have in robotics systems? | Yrs | Mos |

2. How much experience do you have with mechanical robotics using the CV System? | Yrs | Mos |

3. To what extent does the CV System save time or take more (add) time to complete instructions for robotics systems?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above? | Yes | No | Don't Know |

4. How would you rate the changes in the quality of robot design and robotic instructions that are attributable to the use of the CV System?

Considerable Improvement — No Change — Degrades Quality

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

5. How much more or less complex are robotics systems and instructions now being developed using the CV System compared with the systems developed manually?

Less Complex	More Complex
- %	+ %
No Change	

6. To what extent has the CV System helped you (your employees) do a better job in developing robotic systems and instructions?

High Benefit — No Change — Degrades Performance

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

Questionnaire #

7. What do you need or what would it take in expanded CV System capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____
_____
_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 4.1 SCHEMATIC ELECTRONIC DESIGN

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire T

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

4.1 ELECTRONIC SCHEMATIC DESIGN

1. How much experience do you have in electronic schematic design? | Yrs | Mos |

2. How much experience do you have with electronic schematic design using the CV System? | Yrs | Mos |

3. Approximately how many electronic schematic design jobs have you (or your employees) worked on during the past 12 months using the CV System? |_____|

   o How many were new (original) designs? |_____|

   o How many were changes to schematics resident on the CV System (including above new designs)? |_____|

4. To what extent does use of the CV System save time or take more (add) time to complete a new electronic schematic design compared to manual methods for:

	Saves Time	Adds Time
o small (simple) schematics?	% / No Change	%
o large (complex) schematics?	% / No Change	%

5. On the average and based on your (or your employee's) experience, what is the approximate time required to complete a new electronic schematic design using the CV System:

   o Small (simple) schematic? | Days |

   o Large (complex) schematic? | Days |

   • Is data available to substantiate the above? | Yes | No | Don't Know |

Questionnaire #

6. How would you rate the changes in the quality of electronic schematic designs that are attributable to the use of the CV System?

Significant Improvement No Change Significant Degradation

| +7 | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 |

7. How much more or less complex are electronic schematic designs now being developed on the CV System compared with the designs developed manually?

Less More Complex

| - % | + % |
| No Change | |

8. To what extent has the CV System helped you (your employees) do a better job of electronic schematic design?

Very Helpful No Help Degrades Performance

| +7 | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 |

9. How would you rate the system in terms of user friendliness when designing schematics?

Easy To Use No Opinion Difficult To Use

| +7 | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 |

10. How would you rate the system with respect to the friendliness in making changes to schematic designs already residing on the system?

Easy To Change No Opinion Difficult To Change

| +7 | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 |

Questionnaire 1

11. How would you rate the usefulness of the schematic symbols library to enhance system operation?

Very Useful							No Opinion							Wastes Time
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

12. What do you need or what would it take in expanded CV System capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____

_____

_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 4.2 ELECTRONIC SCHEMATIC ANALYSIS

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

4.2 ELECTRONIC SCHEMATIC ANALYSIS

1. How much experience do you have in electronic schematic analysis?

	Yrs		Mos

2. How much experience do you have with electronic schematic analysis using the CV System?

	Yrs		Mos

3. To what extent does the CV System save time or take more (add) time to complete electronic schematic analysis?

Saves Time		Adds Time
%		%
No Change		

- Is data available to substantiate the above?

	Yes		No
	Don't Know		

4. How would you rate the changes in the quality of electronic schematic analysis attributable to the analysis capabilities available on the CV System?

Much Improved							No Change						Quality Degraded
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

5. How much more or less complex are electronic schematic analyses now being developed on the CV System compared with schematic analyses performed manually?

Less Complex		More Complex
- %		+ %
No Change		

6. To what extent has the CV System helped you (your employees) do a better job of schematic analysis?

High Benefit							No Change						Degrades Performance
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. How would you rate the user friendliness of the system's circuit analysis capabilities?

Easy To Use							No Opinion							Difficult To Use
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

8. What do you need or what would it take in expanded CV System capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____
_____
_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 4.3 ELECTRONIC SCHEMATIC DRAFTING

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (Ø) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

4.3 ELECTRONIC SCHEMATIC DRAFTING

1. How much experience do you have in electronic schematic drafting? | Yrs | Mos |

2. How much experience do you have with electronic schematic drafting using the CV System? | Yrs | Mos |

3. Approximately how many electronic schematic drawing jobs have you (or your employees) worked on during the past 12 months using the CV System? |_____|

   o How many were new (original) drawings? |_____|

   o How many were changes to schematics resident on the CV System (including above new designs)? |_____|

4. To what extent does use of the CV System save time or take more (add) time to complete a new electronic schematic drawing compared to manual methods for:

	Saves Time	Adds Time
o small (simple) schematics?	%	%
	No Change	
o large (complex) schematics?	%	%
	No Change	

5. On the average and based on your (or your employee's) experience, what is the approximate time required to complete a new electronic schematic drawing using the CV System:

   o Small (simple) schematic? | Days |

   o Large (complex) schematic? | Days |

   * Is data available to substantiate the above? | Yes | No | Don't Know |

Questionnaire #

6. How would you rate the changes in the quality of schematic drawings that are attributable to the use of the CV System?

Significant Improvement							No Opinion							Significant Degradation
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. How much more or less complex are schematic drawings now being developed on the CV System compared with schematics drawn manually?

Less Complex	More Complex
- %	+ %
No Change	

8. To what extent has the CV System helped you (your employees) do a better job of schematic drafting?

Very Helpful							No Help							Degrades Performance
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

9. How would you rate the system in terms of user friendliness when inputing schematics into the system?

Easy To Use							No Opinion							Difficult To Use
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

10. To what extent does the CV System save time or take more (add) time to make changes to schematic drawing compared to manual methods?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

11. How would you compare the friendliness of the CV System in making changes to schematic drawings already existing on the system versus making changes to schematic drawings manually?

Easy To Change							No Opinion							Difficult To Change
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

Questionnaire F

12. How would you rate the usefulness of a schematic symbols library to enhance ease of drafting schematics?

Very Useful							No Opinion							Wastes Time
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

13. What do you need or what would it take in expanded schematic drafting capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____

_____

_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 5.1 ELECTRONIC PRINTED CIRCUIT BOARD (PCB) LAYOUT

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

5.1 ELECTRONIC PRINTED CIRCUIT BOARD (PCB) LAYOUT

1. How much experience do you have in electronic PCB design? | Yrs | Mos |

2. How much experience do you have with electronic PCB layout using the CV System? | Yrs | Mos |

3. Approximately how many electronic PCB layout jobs have you (or your employees) worked on during the past 12 months using the CV System? |_____|

   o How many were new (original) layouts? |_____|

   o How many were changes to layouts resident on the CV System (including the above new designs)? |_____|

4. To what extent does use of the CV System save time or take more (add) time to complete a new electronic PCB layout compared to manual methods for:

	Saves Time	Adds Time
o small (simple) layouts?	%	%
	No Change	
o large (complex) layouts?	%	%
	No Change	

5. On the average and based on your (or your employee's) experience, what is the approximate time required to complete a new electronic PCB layout using the CV System:

   o Small (simple) layout? | Days |

   o Large (complex) layout? | Days |

   • Is data available to substantiate the above? | Yes | No | Don't Know |

Questionnaire #

6. How would you rate the changes in the quality of PCB layouts attributable to the use of the CV System?

Significant Improvement							No Change							Significant Degradation
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. How much more or less complex are PCB layout designs now being developed on the CV System compared with the same layouts developed manually?

Less Complex	More Complex
- %	+ %
No Change	

8. To what extent has the CV System helped you (your employees) do a better job of PCB layouts?

Very Helpful							No Help							Degrades Performance
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

9. How would you rate the system in terms of user friendliness when laying out PCB's?

Easy To Use							No Opinion							Difficult To Use
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

10. To what extent does the CV System save time or take more (add) time to modify PCB layouts compared to manual methods?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

11. How would you rate the usefulness of a printed circuit component library to enhance system operation?

Very Useful							No Opinion							Wastes Time
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

Questionnaire #

12. What do you need or what would it take in expanded CV System capabilities to do the job better, e.g. training, software packages, output devices, etc?

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 5.2 ELECTRONIC PRINTED CIRCUIT BOARD (PCB) ANALYSIS

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire F

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

5.2 ELECTRONIC PRINTED CIRCUIT BOARD (PCB) ANALYSIS

1. How much experience do you have in electronic printed circuit board (PCB) analysis?

	Yrs	Mos

2. How much experience do you have with electronic PCB analysis using the CV System?

	Yrs	Mos

3. To what extent does the CV System save time or take more (add) time to complete electronic PCB analysis?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

4. How would you rate the changes in the quality of the finished PCB as a result of use of the CV System analysis capability?

High Improvement							No Improvement							Degrades Quality
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

5. How much more or less complex are electronic PCB analyses now being performed on the CV System compared with those performed manually?

Less Complex	More Complex
- %	+ %
No Change	

6. To what extent has the CV System helped you (your employees) do a better job of PCB analysis?

High Benefit							No Benefit							Degrades Performance
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

Questionnaire #

7. How would you rate the CV system in terms of user friendliness in analyzing PCB layouts?

Easy To Use No Opinion Difficult To Use

| +7 | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 |

8. What do you need or what would it take in expanded CV System PCB analysis capabilities to do the job better, e.g. training, software packages, output devices, etc?

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 5.3 ELECTRONIC PRINTED CIRCUIT BOARD (PCB) DRAFTING

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (Ø) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

5.3 ELECTRONIC PRINTED CIRCUIT BOARD (PCB) DRAFTING

1. How much experience do you have in electronic PCB drafting? | Yrs | Mos |

2. How much experience do you have with electronic PCB drafting using the CV System? | Yrs | Mos |

3. Approximately how many electronic PCB drafting jobs have you (or your employees) worked on during the past 12 months using the CV System? |

   o How many were new (original) drawings? |

   o How many were changes to drawings resident on the CV System (including above new designs)? |

4. To what extent does use of the CV System save time or take more (add) time to complete a new electronic PCB drawings compared to manual drawing methods for:

	Saves Time	Adds Time
o small (simple) drawings?	%	%
	No Change	
o large (complex) drawings?	%	%
	No Change	

5. On the average and based on your (or your employee's) experience, what is the approximate time required to complete a new electronic PCB drawing using the CV System:

   o Simple (small) drawing? | Days |

   o Large (complex) drawing? | Days |

Questionnaire #

6. How would you rate the changes in the quality of PCB detailed drawings that are attributable to the use of the CV System?

Significant Improvement							No Change							Significant Degradation
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. How much more or less complex are electronic PCB's now being drawn on the CV System compared with those drawn manually?

Less Complex	More Complex
- %	+ %
No Change	

8. To what extent has the CV System helped you (your employees) do a better job of PCB drafting?

High Benefit							No Change							Degrades Performance
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

9. How would you rate the system in terms of user friendliness when laying out a PCB?

Easy To Use							No Opinion							Difficult To Use
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

10. To what extent does the CV System save time or take more (add) time in making changes to electronic PCB drawings compared to changing manually prepared drawings?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

Questionnaire #

11. Does your CV System have a PCB symbol library installed?

Yes	No

* If answer to above is "Yes", how would you rate the usefulness of the PCB symbols library to enhance ease of layout drafting?

Very Useful — No Opinion — Wastes Time

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

12. What do you need or what would it take in expanded CV System PCB layout capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____
_____
_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 5.4 ELECTRONIC PRINTED CIRCUIT BOARD (PCB) MANUFACTURING

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

5.4 ELECTRONIC PCB MANUFACTURING

1. How much experience do you have in electronic PCB manufacturing?

	Yrs	Mos

2. How much experience do you have with electronic PCB manufacturing using the CV System?

	Yrs	Mos

3. To what extent does the CV System save time or take more (add) time to manufacture a PCB?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

4. How would you rate the changes in the quality of electronic PCB's that are attributable to the use of the electronic PCB manufacturing features on the CV System?

Highly Improved — No Improvement — Degrades Quality

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

5. How much more or less complex are PCB NC programs now being developed on the CV System compared with those developed manually?

Less Complex	More Complex
- %	+ %
No Change	

6. To what extent has the CV System helped you (your employees) do a better job of producing PCB's?

High Benefit — No Benefit — Degrades Performance

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. How would you rate the system in terms of effectiveness for manufacturing (i.e. numerical control for PCB drilling applications)?

Highly Effective							No Help							Reduces Effectiveness
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

8. What do you need or what would it take in expanded CV System PCB NC program capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____

_____

_____

COMMENTS:

Questionnaire
Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 6.1 ARCHITECTURAL & ENGINEERING CONSTRUCTION

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (0) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

6.1 ARCHITECTURAL/ENGINEERING CONSTRUCTION

1. How much experience do you have in architectural/engineering construction?

Yrs	Mos

2. How much experience do you have with architectural/engineering construction using the CV System?

Yrs	Mos

3. To what extent does the CV System save time or take more (add) time to complete architectural/-engineering construction designs, layouts or drawings?

Saves Time	Adds Time
%	%
No Change	

- Is data available to substantiate the above?

Yes	No
Don't Know	

4. How would you rate the changes in the quality of architectural/-engineering construction designs, layouts or drawings that are attributable to the use of the CV System?

Significant Improvement — No Change — Quality Degraded

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

5. How much more or less complex are the architectural/engineering construction designs, layouts or drawings now being developed on the CV System compared with these developed manually?

Less Complex	More Complex
- %	+ %
No Change	

6. To what extent has the CV System helped you (your employees) do a better job of architectural/engineering construction design, layouts or drawings?

High Benefit — No Benefit — Degrades Performance

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. What do you need or what would it take in expanded CV System capabilities to do the job better, e.g. training, software packages, output devices, etc?

_____
_____
_____

COMMENTS:

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

Respondees are requested to complete questions 1 through 7 as appropriate opposite each of the application areas described in a through m. If a "Yes" answer is appropriate in column (1) then the respondee should provide answers to questions 2 through 7 for that application area. If your answer is "No" in column (1) please do not complete the questions under 2 through 7 for that application area.

ARCHITECTURAL ENGINEERING CONSTRUCTION	1		2	3	4	5	6	7
	Indicate whether or not you work in this application or functional area.		What percent of the full CV System AEC capability in this area are you using?	To what extent do you use the CV System in this application area to perfom your work? (10 -All the time; 1 - Never)	What impact has the CV System had in this area on your productivity compared to manual methods?	To what extent has use of the CV System in this area effected the quality of your work? (10 - Major impact; 1 - No effect)	What impact has the CV System had on the cost to complete AEC designs in these areas? (10 - Major cost reduction 1 - No impact or added cost)	What impact has the CV System had in this area on construction or modification costs? 10 - Major cost reduction 1 - No impact or added cost)
APPLICATION OR FUNCTIONAL AREAS	Yes	No	%	(10 - 1)	%	(10 - 1)	(10 - 1)	(10 - 1)
a) Mapping								
b) Site Engineering								
c) Architectural Plans								
d) Visualization (3D)								
e) Structure Design								
f) HVAC								
g) Power & Lighting (Elec)								
h) Plumbing & First Protection								
i) Equipment (Component Library)								
j) Construction Drawings								
k) Schedules								
l) Change Orders								
m) Facilities Management								

Questionnaire Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 7.3 PUBLICATIONS DRAFTING/DETAILING
(TECHNICAL ILLUSTRATION)

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (Ø) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

7.3 PUBLICATIONS DRAFTING/DETAILING (TECHNICAL ILLUSTRATION)

1. How much experience do you have in technical illustration for publications? | Yrs | Mos |

2. How much experience do you have in technical illustration for publications using the CV System? | Yrs | Mos |

	Saves Time	Adds Time
3. To what extent does the CV System save time or take more (add) time to complete technical illustrations for publications?	%	%
	No Change	
• Is data available to substantiate the above?	Yes	No
	Don't Know	

4. How would you rate the changes in the quality of technical illustrations that are attributable to the use of the CV System?

Significant Improvement No Change Significant Degradation

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

	Less Complex	More Complex
5. How much more or less complex are technical illustrations now being developed on the CV System compared with those accomplished manually?	- %	+ %
	No Change	

6. To what extent has the CV System helped you (your employees) do a better job of technical illustrations?

Very Helpful No Help Degrades Performance

+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

7. To what extent has the systems drafting/detailing capability improved technical illustration productivity? | % |

• Is data available to substantiate the above? | Yes | No | / | Don't Know |

Questionnaire F

8. To what extent has the CV System permitted the use of earlier technical illustrations to produce new illustrations?

Very Useful							No Opinion							Wastes Time
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

9. Do you have the capacity to electronically merge CV System generated technical illustrations with text? | Yes | No |

- If "Yes", what productivity value would you assign to this capability?

Significant Improvement							No Change							Significant Degradation
+7	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7

- If "Yes", what systems/software are you using to achieve the capability?

_____ _____ _____ _____ _____

10. What do you need or what would it take in expanded CV System capabilities to do the job of detailed mechanical design better e.g. training, software packages, output devices, etc?

_____
_____
_____

COMMENTS:

Questionnaire Number

NAVY LABORATORY

CAD/CAM PRODUCTIVITY SURVEY

QUESTIONNAIRE

SECTION 7.6 PUBLICATIONS GRAPHICS ARTS

PLEASE READ BEFORE PROCEEDING

The questions in this survey request several types of answers, namely, a percentage value, month or years experience, number of jobs worked on, or a value in a response matrix ranging from plus seven (+7) to minus seven (-7). The type of answer desired is indicated opposite each question. Where a response matrix is shown, the plus seven (+7) always represents high benefit or the most favorable impact i.e. my employees couldn't do their job without the system. The minus seven (-7) always represents a detrimental effort i.e. degrades production, or adversely effects quality. A zero (Ø) value indicates no change when compared to manual methods.

Questionnaire #

NAVY LABORATORY
CAD/CAM SURVEY QUESTIONNAIRE

7.6 PUBLICATIONS GRAPHICS ARTS

1. How much experience do you have in graphics arts? | Yrs | Mos |

2. How much experience do you have with the CV System? | Yrs | Mos |

3. Has the CV System been used in the publications/ graphics arts area? | Yes | No |

4. If the answer to question 3 is "Yes", to what extent has the CV System helped you (your employees) do a better job of developing graphics arts for publications?

Very Helpful — No Help — Degrades Performance

| +7 | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 |

- Is data available to substantiate the above? | Yes | No | Don't Know |

5. What do you need or what would it take in expanded CV System capabilities to do the job of drafting/detailing better (e.g. training, software packages, output devices, etc)?

_____
_____
_____

COMMENTS:

Appendix E

LABORATORY PROFILES

LABORATORY PROFILES

CAEDOS system operations	Annapolis	China Lake	Carderock	Dahlgren	New London	Newport	Orlando	Panama City	San Diego	Warminster	White Oak	Totals
Application areas	All	All	Mech & El	All	All	All	Mech & El	All	All	All	All	
Workstations (shifts)												
Open shop		10(25)	18(1)					7(1.2)	6(1)	7(1.5)	4(1)	
Closed shop	7(1)	20(1.25)		25(1)		3(1)	3(1)	1(1)	9(1)			
Dedicated					18(1)	19(1)			5(1)	9(1)	19(1)	
Total	7	30	18	25	18	22	3	8	18	16	23	188
Users (government)												
Full time	5	40	7	20	12	5		6	9	1	12	
Part time	5		12	20	35	30	3	3	10		11	
Intermittent	5	40	4	92	30	30	1	2	3	17	15	
Users (contractor)												
Full time		30	3	10	2	5			11	1		
Part time				2	2	10		2				
Intermittent					4	5				5		
Total users	15	110	26	144	85	85	4	13	33	24	38	577
Trainees												
Government employees	19	250	75	90	120	40(Est)	3	30	87	24(Est)	85	
Contractor employees					10			5				
Total trainees	19	250	75	90	130	40(Est)	3	35	87	24(Est)	85	
Financial/accounting data												
Single or multiple work centers	Single	Multiple	Single	Single	Single	Single	Single	Single	Single	Multiple	Single	
Funding method												
Laboratory overhead (%)		30		100	100	100	100	70			100	
Direct budget (%)	100	50	100					30	100			
Dept (prog-pros) %		20										
Cost data												
Rate/hour	$33	$57	$33					$25	$36			
Rate/yr		$11000							$57000			

Appendix F

SURVEY QUESTIONNAIRE RESPONSES

SURVEY QUESTIONNAIRE RESPONSES

Section	Annapolis	China Lake	Carderock	Dahlgren	New London	Newport	Orlando	Panama City	San Diego	Warminster	White Oak	Totals
Personal profile	9	44	8	17	24	10	4	11	18	16	30	191
Satisfaction survey	9	44	8	17	24	10	4	11	18	16	30	191
Mechanical design	7	16	7	7	10	7		5	9	3	13	84
Mechanical analysis	4	6	3	3	3	5		3	1	1	9	38
Mechanical detailing	8	24	1	6	10	3	4	4	10	3	15	88
Mechanical manufacturing	2	5		4	2			1	1		2	17
Mechanical robotics											1	1
Schematic design	2	5		1	6	1		3	2	4	24	
Schematic analysis		4								2	2	8
Schematic detailing	2	18		4	2	1	3	2	7	3	4	46
PCB design		9		2	2	1		3	3		6	26
PCB analysis		4			1			3		2	10	
PCB detailing		14			1			1	3	1	2	22
PCB manufacturing		3		1	1			1	3	1	1	11
Architectural engineering and construction		3			4	2		3	5	2	19	
Publications illustration				3	4		1		1	1		10
Graphic arts				3	6				1	1		11
Total by laboratory	43	199	27	68	100	40	16	42	84	55	123	797

Appendix G

PARTICIPANTS BY APPLICATION AREA

PARTICIPANTS BY APPLICATION AREA

Application area	Number	%
1. Mechanical only	94	49.30
2. Electrical only	36	18.80
3. Mechanical and electrical	25	13.10
4. Architectural engineering and construction (AEC)	12	6.30
5. System managers (excludes San Diego)	10	5.20
6. Electrical and publications	5	2.60
7. Mechanical and AEC	4	2.10
8. Publications only	3	1.60
9. Electrical and AEC	1	.50
10. Mechanical, electrical, and AEC	1	.50
Total participants	191	100.00

Appendix H

PERCENTAGE OF TOTAL CAEDOS USERS PARTICIPATING IN SURVEY

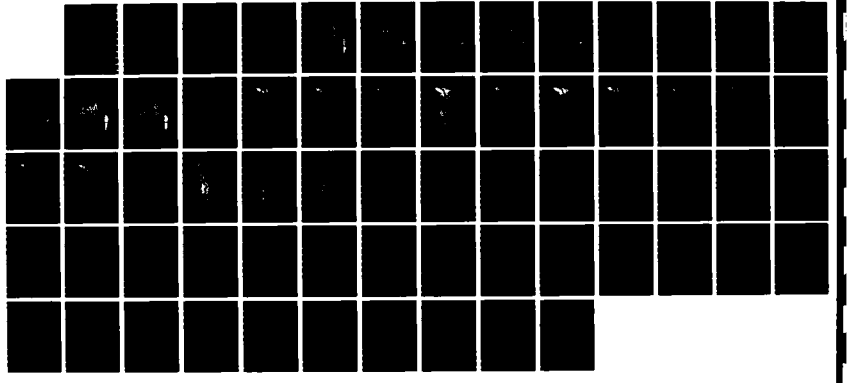
PERCENTAGE OF TOTAL CAEDOS USERS
PARTICIPATING IN SURVEY

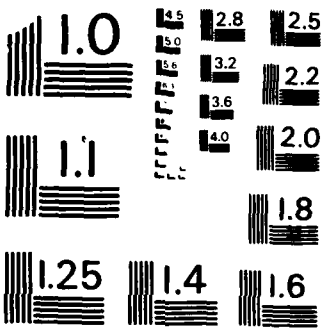
Type of user	Number of users reported in laboratory profile	Type of user, %	Hands-on users participating in survey	Percentage of hands-on users participating
Full time	179	31	85	48
Part time	145	25	53	37
Intermittent	253	44	38	15
Overall	577	100	176[a]	31

[a] Excludes 15 participants—managers or supervisors who are not hands-on users.

AD-A169 809 COMPUTER-AIDED ENGINEERING AND DOCUMENTATION SYSTEM (CAEDOS) PRODUCTIVITY..(U) NAVAL WEAPONS CENTER CHINA LAKE CA APR 86 NWC-TP-6698 SBI-AD-E900 585 2/2

UNCLASSIFIED F/G 9/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

Appendix I

PERSONAL PROFILE OF SURVEY PARTICIPANTS

PERSONAL PROFILE OF SURVEY PARTICIPANTS

Laboratory	Number responses	Age (years)				Manager superv.	Hands-on users		
		Mean	Max	Min	Std. dev.		Full	Part	Intermittent
Annapolis	9	32.3	46	23	7	1	3	5	1
China Lake	44	32.6	58	19	10.3	10	24	9	8
Carderock	8	27.1	47	19	8.7	0	5	2	1
Dahlgren	17	29.7	50	19	8.6	5	9	5	3
New London	24	32.7	59	23	9.4		7	10	6
Newport	10	33.5	63	22	12.3	2	3	3	4
Orlando	4	42.0	56	23	17.2	1		3	1
Panama City	11	30.7	55	23	9.8		3	3	4
San Diego	18	41.4	61	26	11.1	5	13	1	
Warminster	16	33.9	60	22	12.8	5	5	4	5
White Oak	30	36.3	68	21	13.3	6	13	8	5
Total/overall	191	33.6	68	19		35[a]	85[a]	53[a]	38[a]

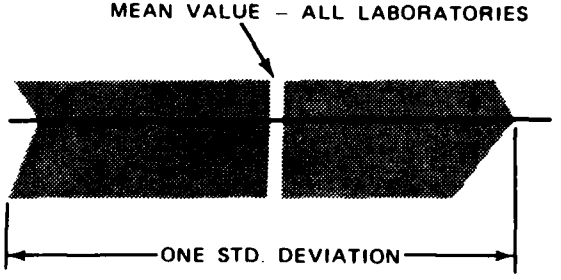
[a] Nineteen manager/supervisors are also listed as hands-on users in the last three columns. Similarly, the last three columns exclude 19 managers or supervisors who are not hands-on users.

Appendix J

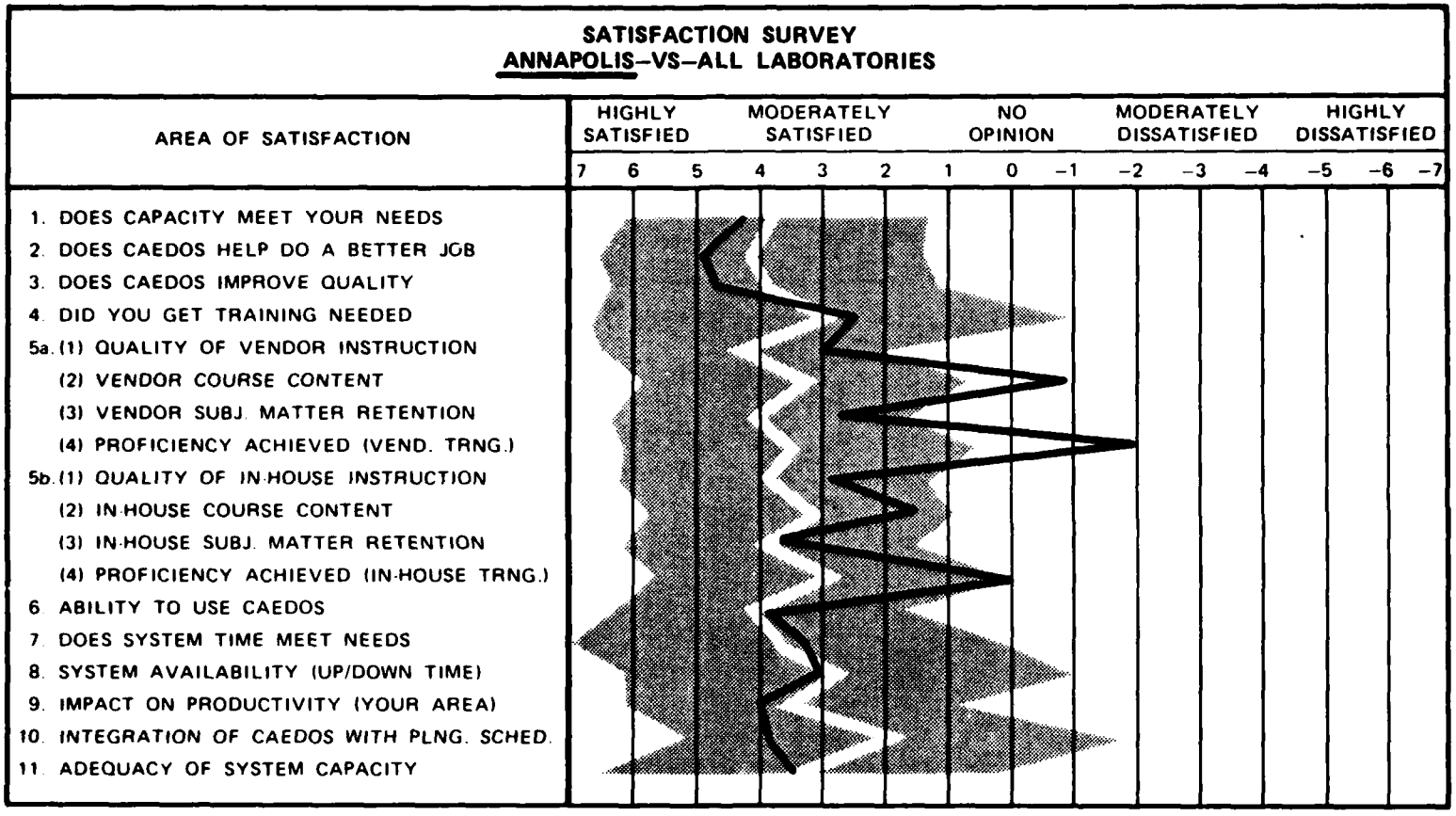
LEVEL OF SATISFACTION WITH CAEDOS

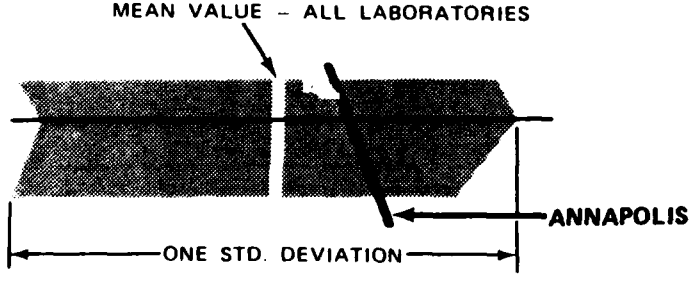
SATISFACTION SURVEY
COMPOSITE ALL LABORATORIES

AREA OF SATISFACTION	HIGHLY SATISFIED			MODERATELY SATISFIED			NO OPINION			MODERATELY DISSATISFIED			HIGHLY DISSATISFIED		
	7	6	5	4	3	2	1	0	−1	−2	−3	−4	−5	−6	−7
1. DOES CAPACITY MEET YOUR NEEDS															
2. DOES CAEDOS HELP DO A BETTER JOB															
3. DOES CAEDOS IMPROVE QUALITY															
4. DID YOU GET TRAINING NEEDED															
5a. (1) QUALITY OF VENDOR INSTRUCTION															
(2) VENDOR COURSE CONTENT															
(3) VENDOR SUBJ MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (VEND. TRNG.)															
5b. (1) QUALITY OF IN-HOUSE INSTRUCTION															
(2) IN-HOUSE COURSE CONTENT															
(3) IN-HOUSE SUBJ MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (IN-HOUSE TRNG.)															
6. ABILITY TO USE CAEDOS															
7. DOES SYSTEM TIME MEET NEEDS															
8. SYSTEM AVAILABILITY (UP/DOWN TIME)															
9. IMPACT ON PRODUCTIVITY (YOUR AREA)															
10. INTEGRATION OF CAEDOS WITH PLNG. SCHED															
11. ADEQUACY OF SYSTEM CAPACITY															



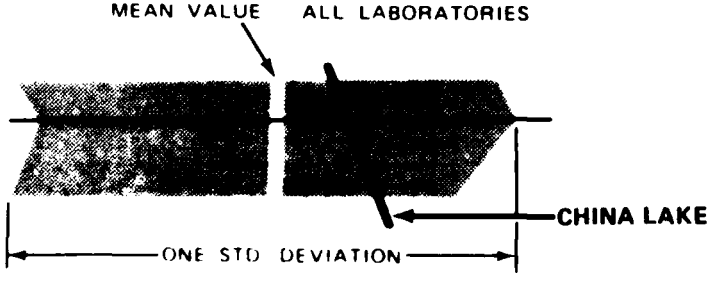
SATISFACTION SURVEY
ANNAPOLIS–VS–ALL LABORATORIES



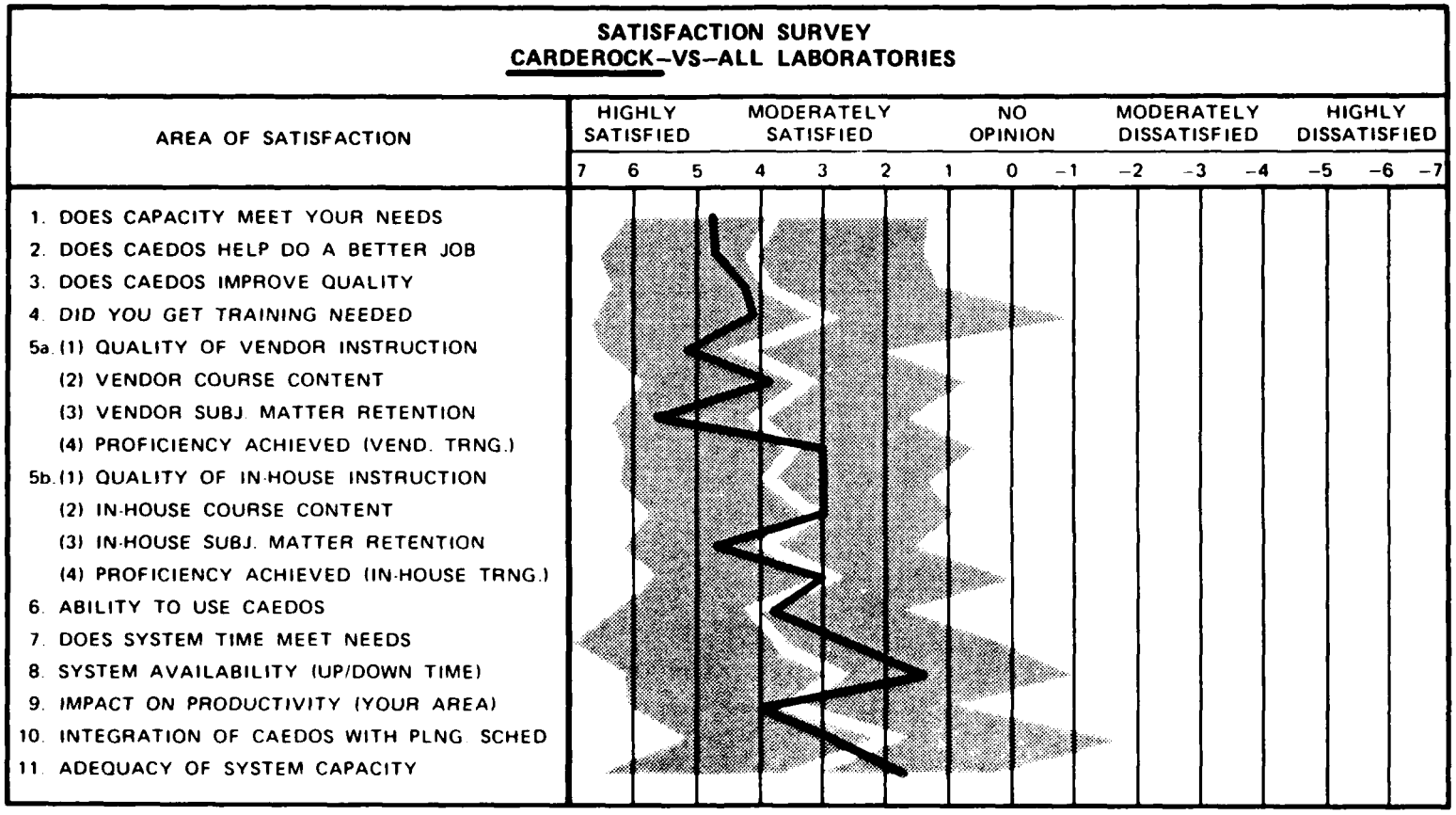


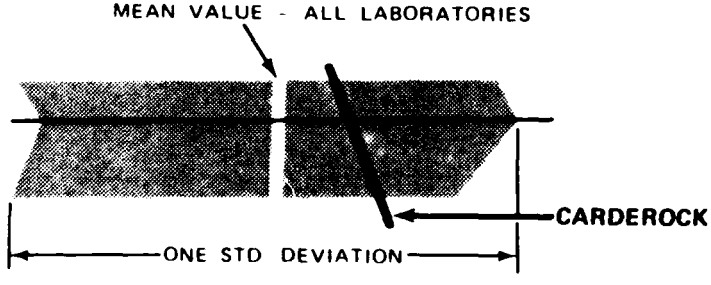
SATISFACTION SURVEY
CHINA LAKE–VS–ALL LABORATORIES

AREA OF SATISFACTION	HIGHLY SATISFIED			MODERATELY SATISFIED			NO OPINION			MODERATELY DISSATISFIED			HIGHLY DISSATISFIED		
	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6	-7
1. DOES CAPACITY MEET YOUR NEEDS															
2. DOES CAEDOS HELP DO A BETTER JOB															
3. DOES CAEDOS IMPROVE QUALITY															
4. DID YOU GET TRAINING NEEDED															
5a. (1) QUALITY OF VENDOR INSTRUCTION															
(2) VENDOR COURSE CONTENT															
(3) VENDOR SUBJ. MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (VEND. TRNG.)															
5b. (1) QUALITY OF IN-HOUSE INSTRUCTION															
(2) IN-HOUSE COURSE CONTENT															
(3) IN-HOUSE SUBJ. MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (IN-HOUSE TRNG.)															
6. ABILITY TO USE CAEDOS															
7. DOES SYSTEM TIME MEET NEEDS															
8. SYSTEM AVAILABILITY (UP/DOWN TIME)															
9. IMPACT ON PRODUCTIVITY (YOUR AREA)															
10. INTEGRATION OF CAEDOS WITH PLNG SCHED															
11 ADEQUACY OF SYSTEM CAPACITY															



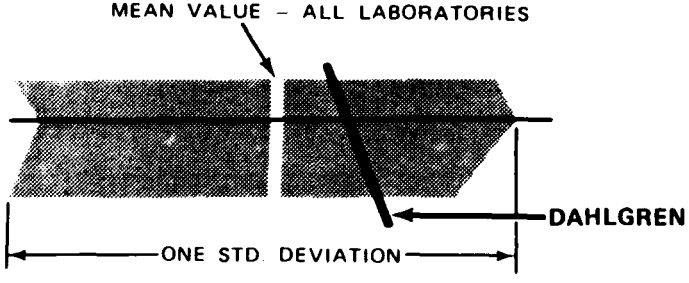
SATISFACTION SURVEY
CARDEROCK–VS–ALL LABORATORIES



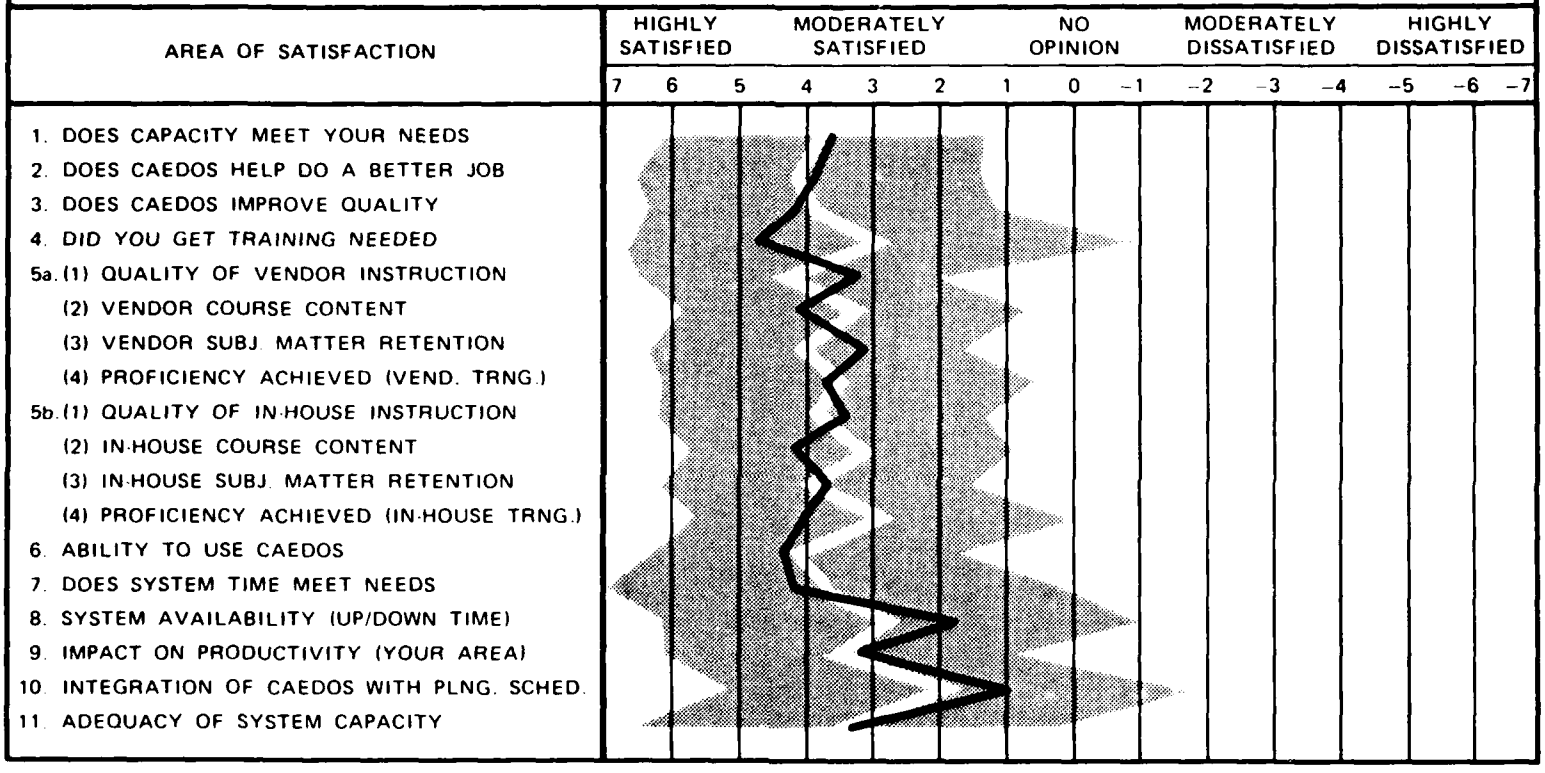


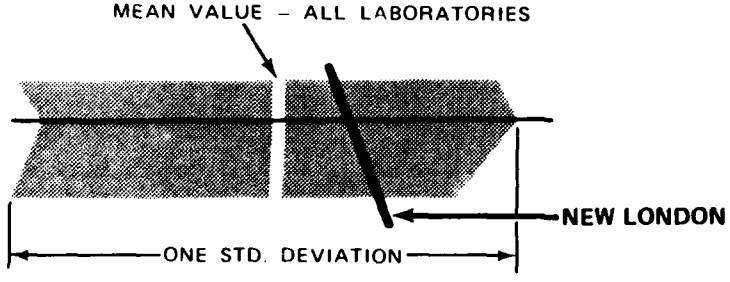
SATISFACTION SURVEY
DAHLGREN–VS–ALL LABORATORIES

AREA OF SATISFACTION	HIGHLY SATISFIED			MODERATELY SATISFIED				NO OPINION		MODERATELY DISSATISFIED			HIGHLY DISSATISFIED		
	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6	-7
1 DOES CAPACITY MEET YOUR NEEDS															
2 DOES CAEDOS HELP DO A BETTER JOB															
3 DOES CAEDOS IMPROVE QUALITY															
4 DID YOU GET TRAINING NEEDED															
5a (1) QUALITY OF VENDOR INSTRUCTION															
(2) VENDOR COURSE CONTENT															
(3) VENDOR SUBJ MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (VEND. TRNG.)															
5b (1) QUALITY OF IN-HOUSE INSTRUCTION															
(2) IN-HOUSE COURSE CONTENT															
(3) IN-HOUSE SUBJ MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (IN-HOUSE TRNG.)															
6 ABILITY TO USE CAEDOS															
7 DOES SYSTEM TIME MEET NEEDS															
8 SYSTEM AVAILABILITY (UP/DOWN TIME)															
9 IMPACT ON PRODUCTIVITY (YOUR AREA)															
10 INTEGRATION OF CAEDOS WITH PLNG. SCHED															
11 ADEQUACY OF SYSTEM CAPACITY															

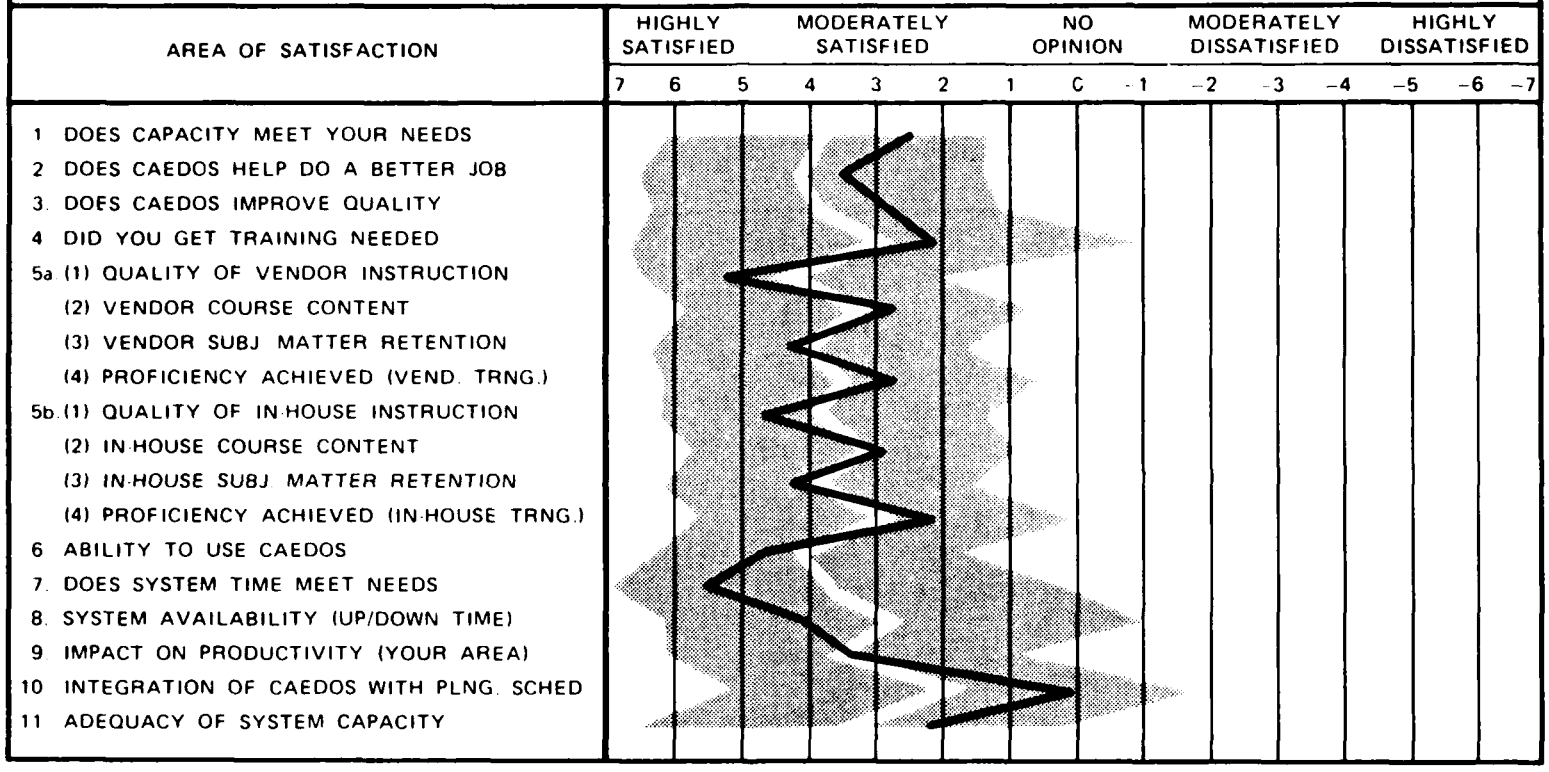


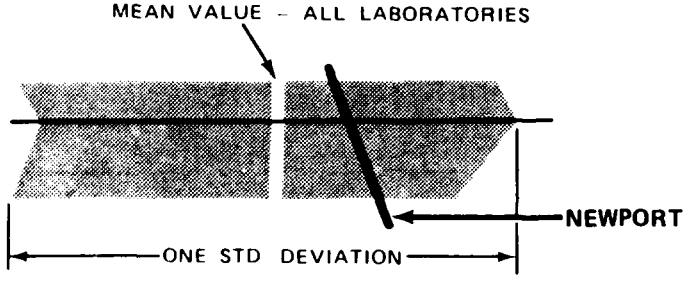
SATISFACTION SURVEY
NEW LONDON–VS–ALL LABORATORIES





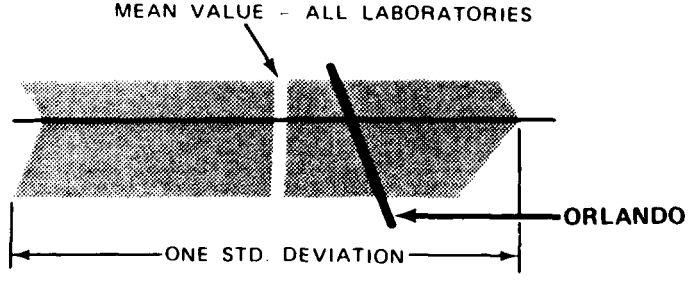
SATISFACTION SURVEY
NEWPORT–VS–ALL LABORATORIES



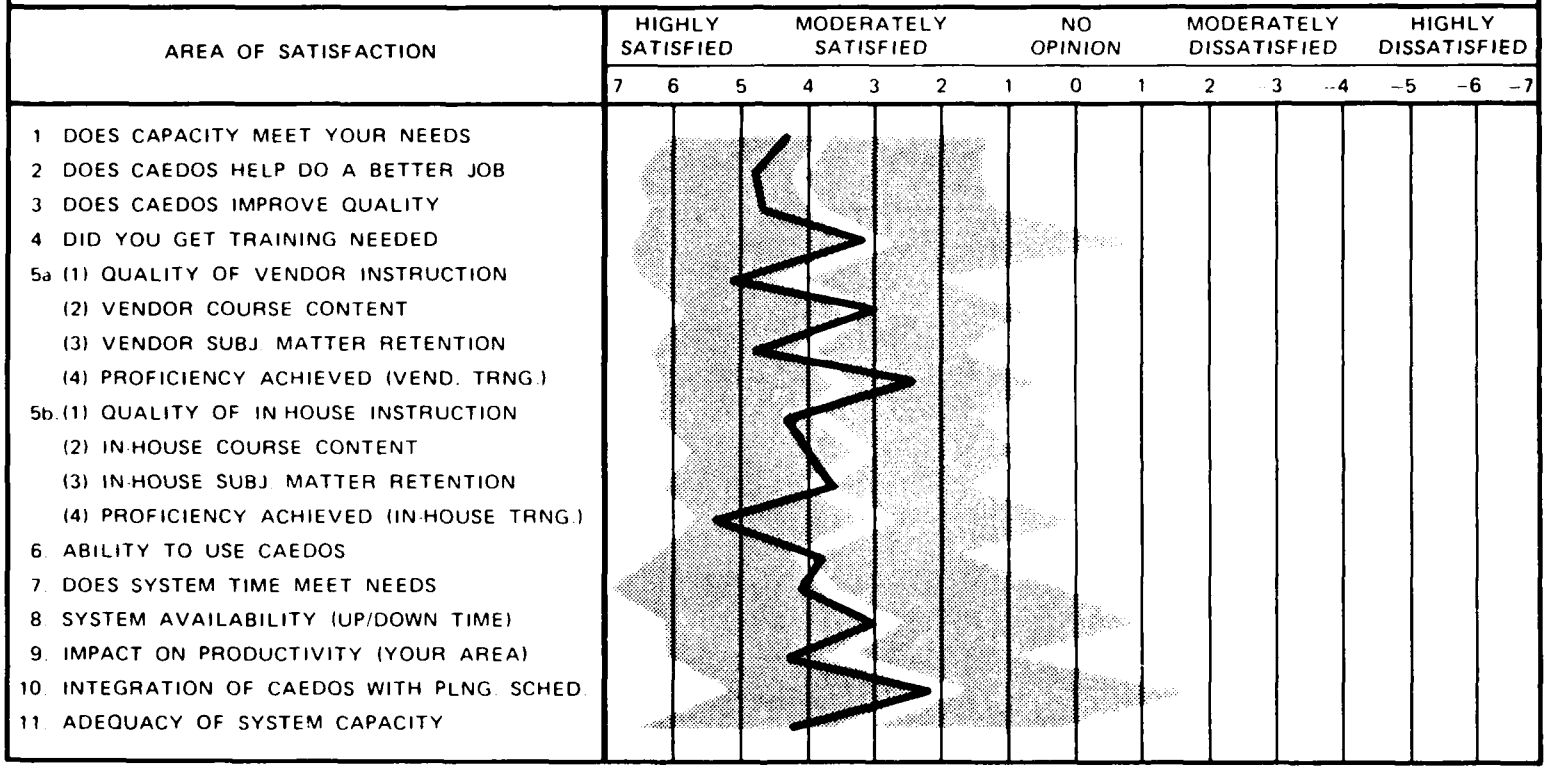


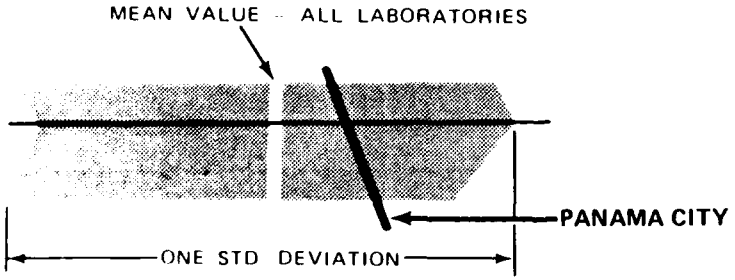
SATISFACTION SURVEY
ORLANDO–VS–ALL LABORATORIES

AREA OF SATISFACTION	HIGHLY SATISFIED			MODERATELY SATISFIED			NO OPINION		MODERATELY DISSATISFIED			HIGHLY DISSATISFIED		
	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7
1. DOES CAPACITY MEET YOUR NEEDS															
2. DOES CAEDOS HELP DO A BETTER JOB															
3. DOES CAEDOS IMPROVE QUALITY															
4 DID YOU GET TRAINING NEEDED															
5a (1) QUALITY OF VENDOR INSTRUCTION															
(2) VENDOR COURSE CONTENT															
(3) VENDOR SUBJ. MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (VEND. TRNG.)															
5b. (1) QUALITY OF IN-HOUSE INSTRUCTION															
(2) IN-HOUSE COURSE CONTENT															
(3) IN-HOUSE SUBJ. MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (IN-HOUSE TRNG.)															
6. ABILITY TO USE CAEDOS															
7. DOES SYSTEM TIME MEET NEEDS															
8. SYSTEM AVAILABILITY (UP/DOWN TIME)															
9. IMPACT ON PRODUCTIVITY (YOUR AREA)															
10. INTEGRATION OF CAEDOS WITH PLNG. SCHED.															
11. ADEQUACY OF SYSTEM CAPACITY															



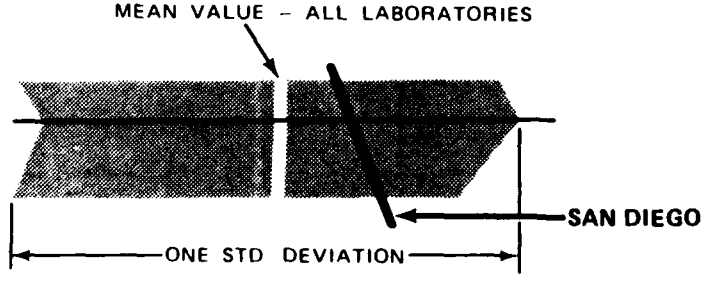
SATISFACTION SURVEY
PANAMA CITY–VS–ALL LABORATORIES



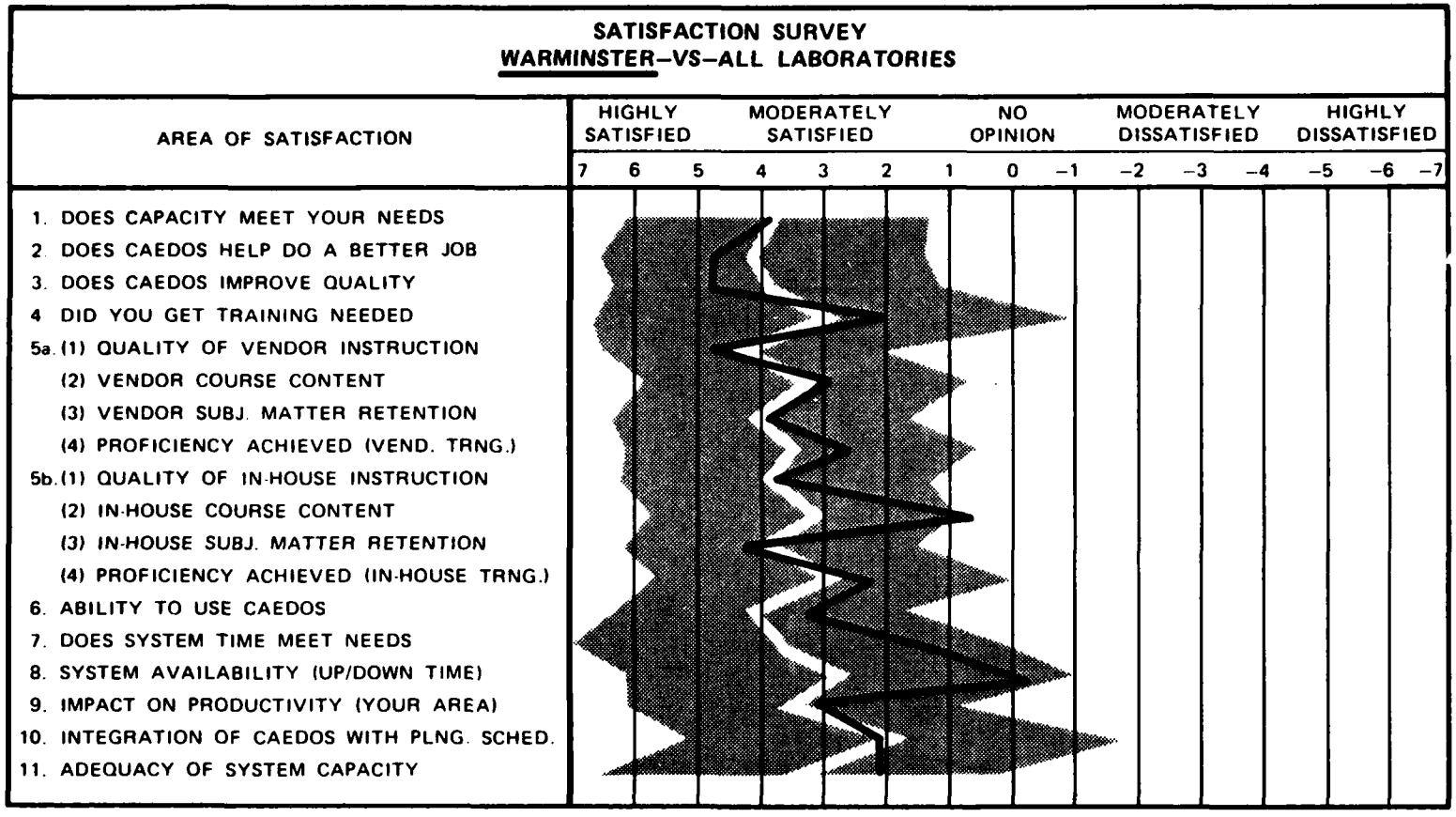


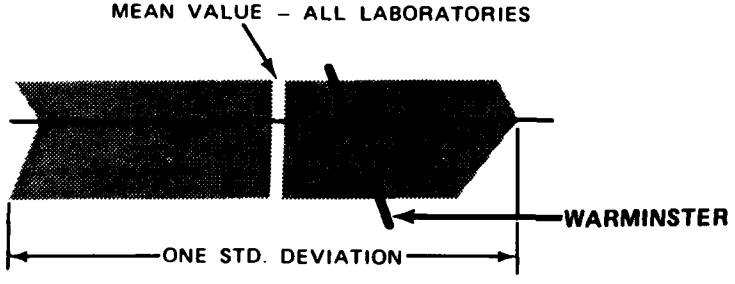
SATISFACTION SURVEY
SAN DIEGO–VS–ALL LABORATORIES

AREA OF SATISFACTION	HIGHLY SATISFIED			MODERATELY SATISFIED			NO OPINION	MODERATELY DISSATISFIED			HIGHLY DISSATISFIED		
	7	6	5	4	3	2	1	0	−1	−2	−3	−4	−5	−6	−7
1. DOES CAPACITY MEET YOUR NEEDS															
2. DOES CAEDOS HELP DO A BETTER JOB															
3. DOES CAEDOS IMPROVE QUALITY															
4. DID YOU GET TRAINING NEEDED															
5a. (1) QUALITY OF VENDOR INSTRUCTION															
(2) VENDOR COURSE CONTENT															
(3) VENDOR SUBJ. MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (VEND. TRNG.)															
5b. (1) QUALITY OF IN-HOUSE INSTRUCTION															
(2) IN-HOUSE COURSE CONTENT															
(3) IN-HOUSE SUBJ. MATTER RETENTION															
(4) PROFICIENCY ACHIEVED (IN-HOUSE TRNG.)															
6. ABILITY TO USE CAEDOS															
7. DOES SYSTEM TIME MEET NEEDS															
8. SYSTEM AVAILABILITY (UP/DOWN TIME)															
9. IMPACT ON PRODUCTIVITY (YOUR AREA)															
10. INTEGRATION OF CAEDOS WITH PLNG. SCHED.															
11. ADEQUACY OF SYSTEM CAPACITY															

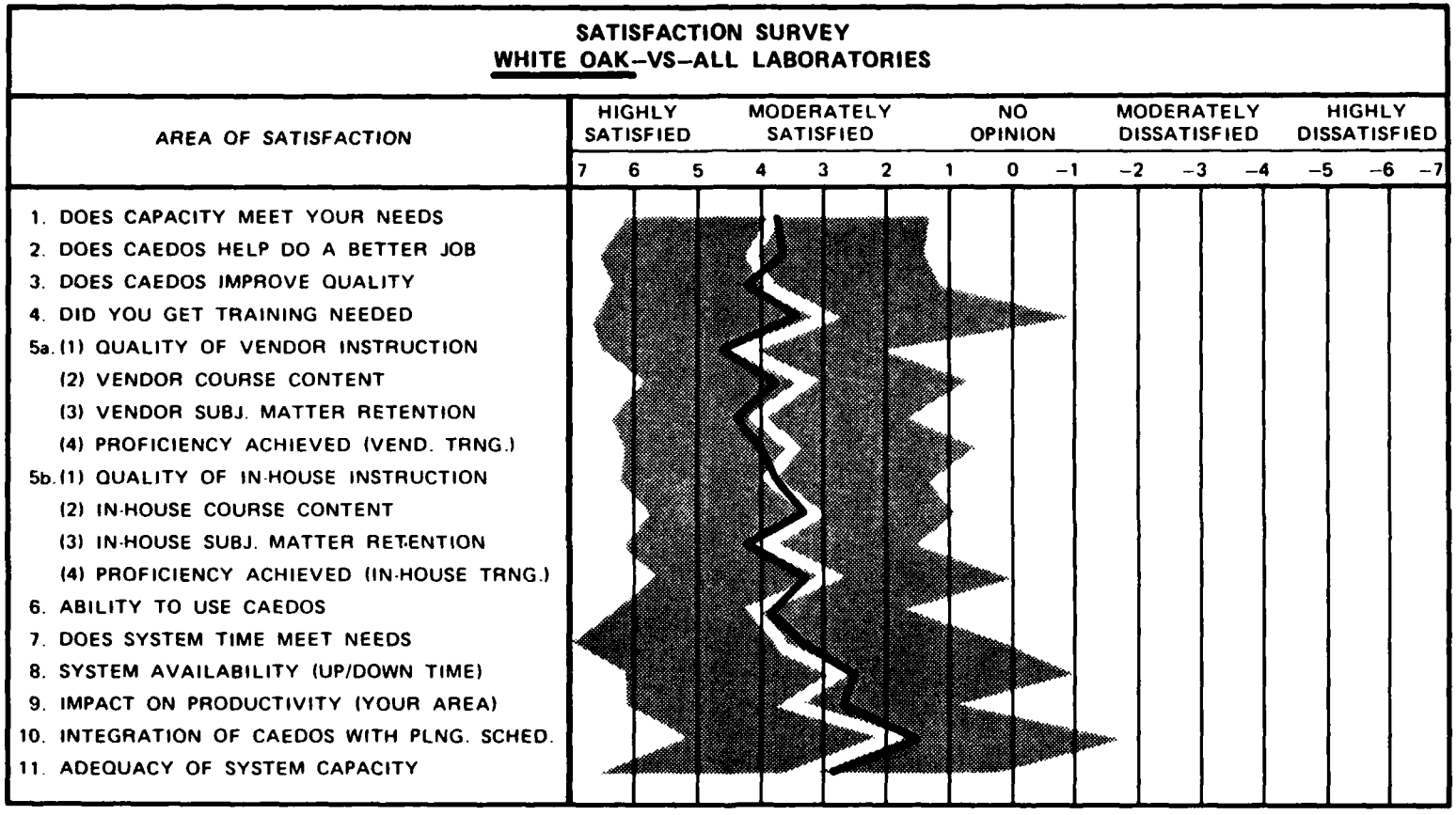


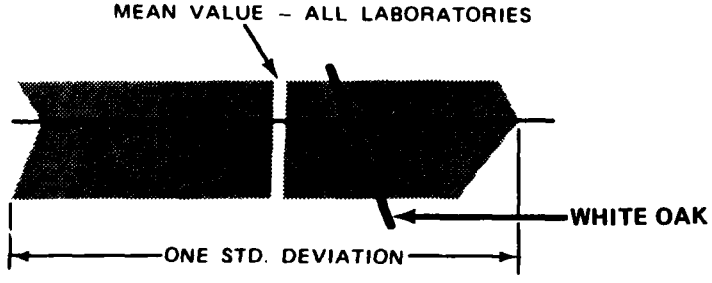
SATISFACTION SURVEY
WARMINSTER–VS–ALL LABORATORIES





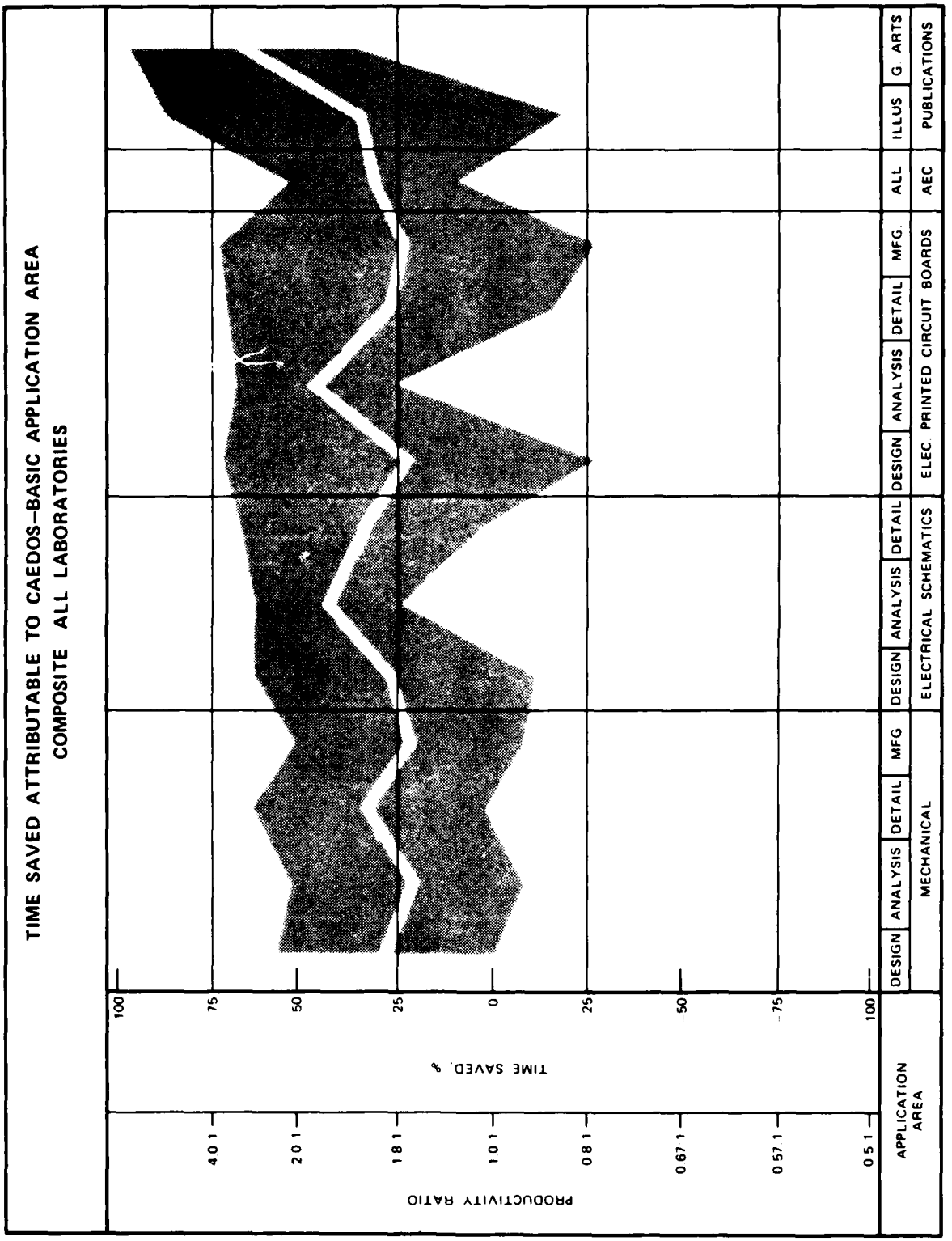
SATISFACTION SURVEY
WHITE OAK–VS–ALL LABORATORIES

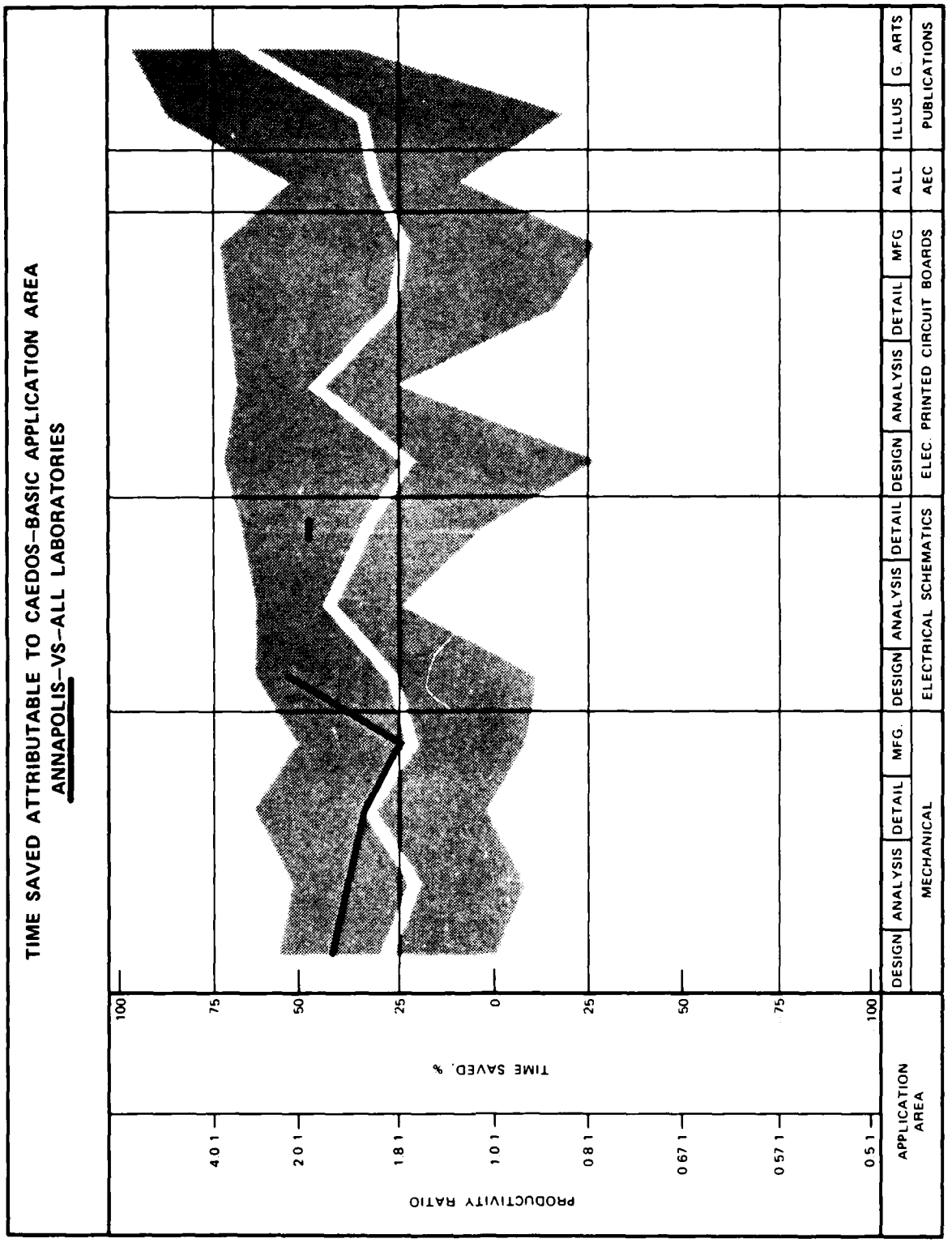


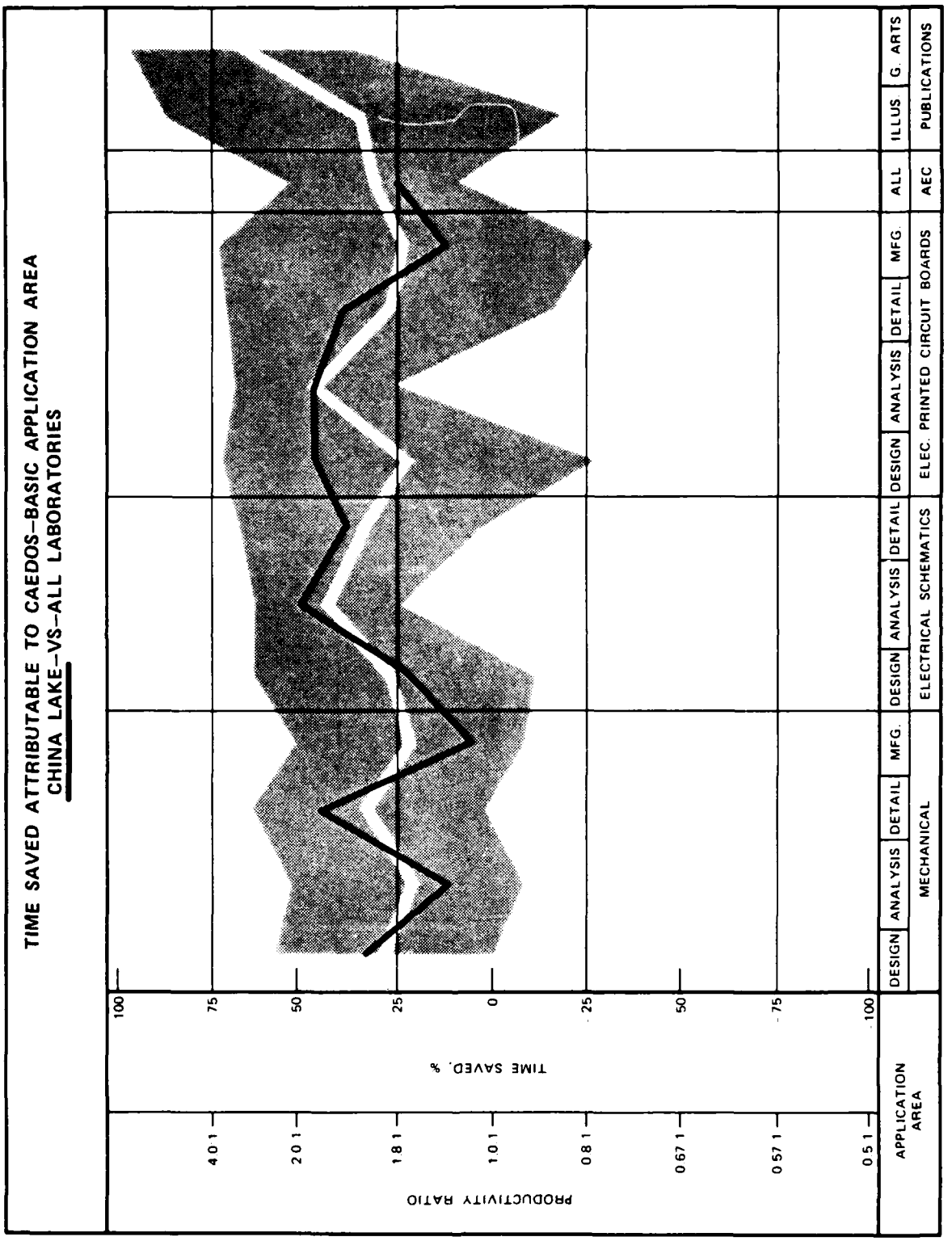


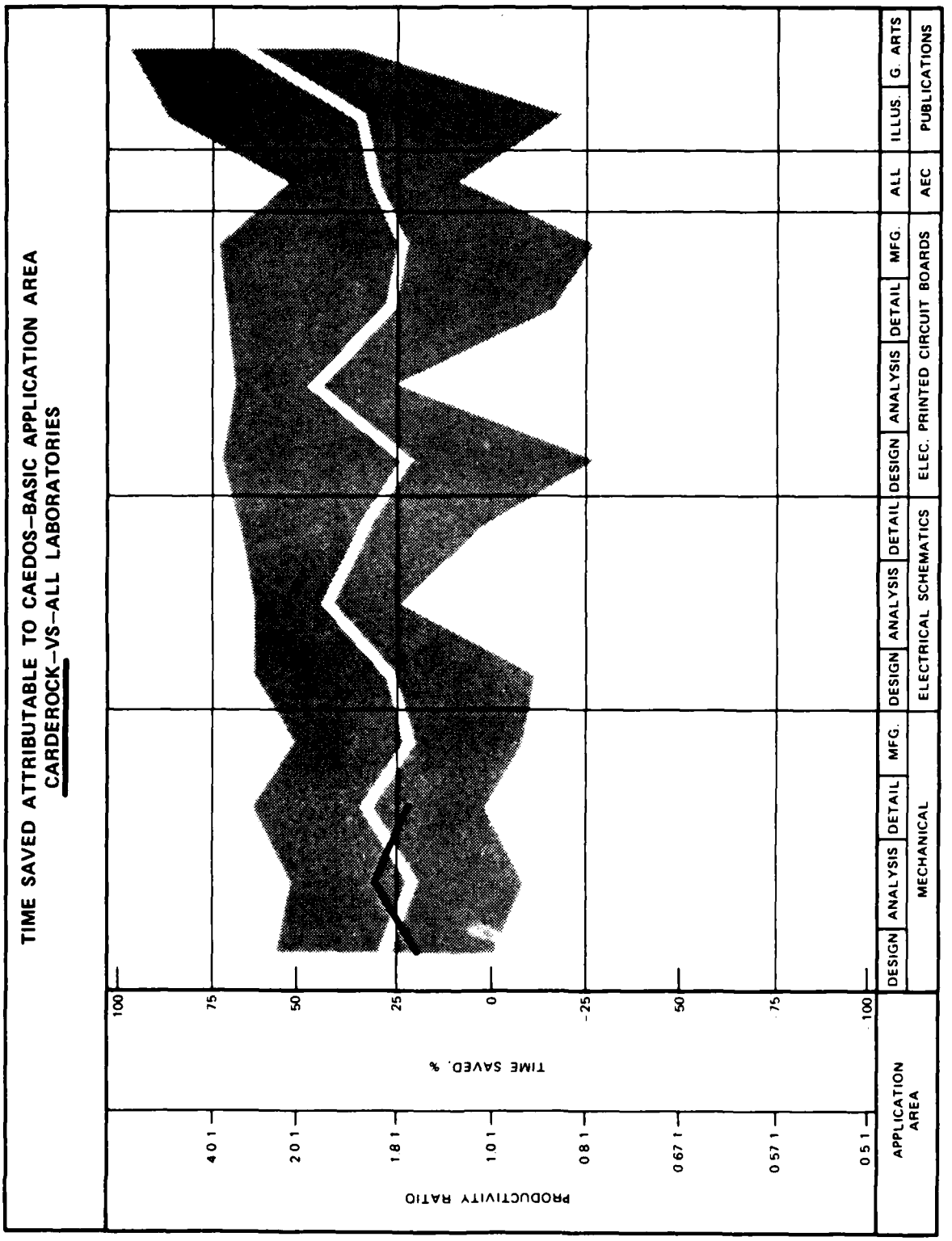
Appendix K

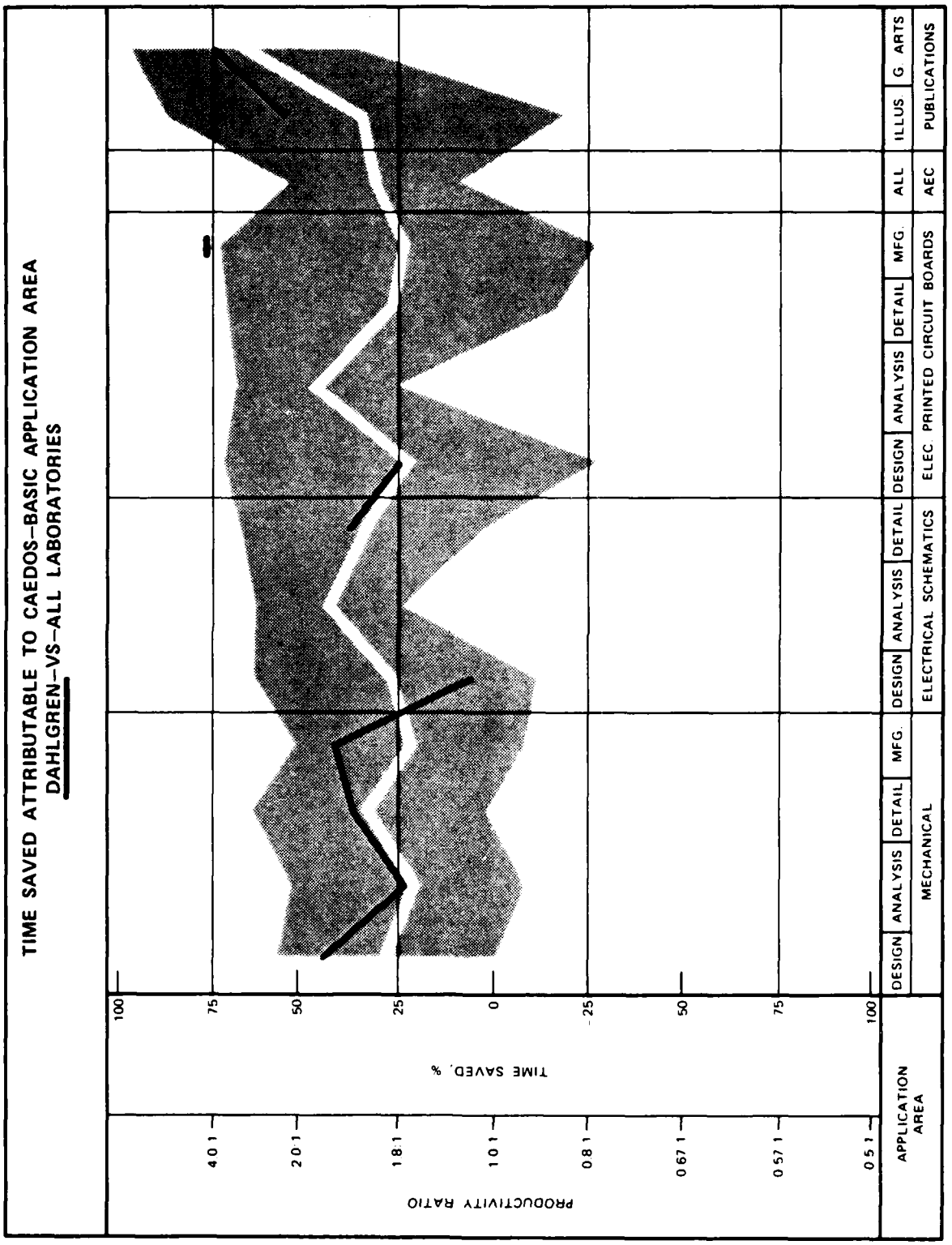
TIME SAVED ATTRIBUTABLE TO CAEDOS

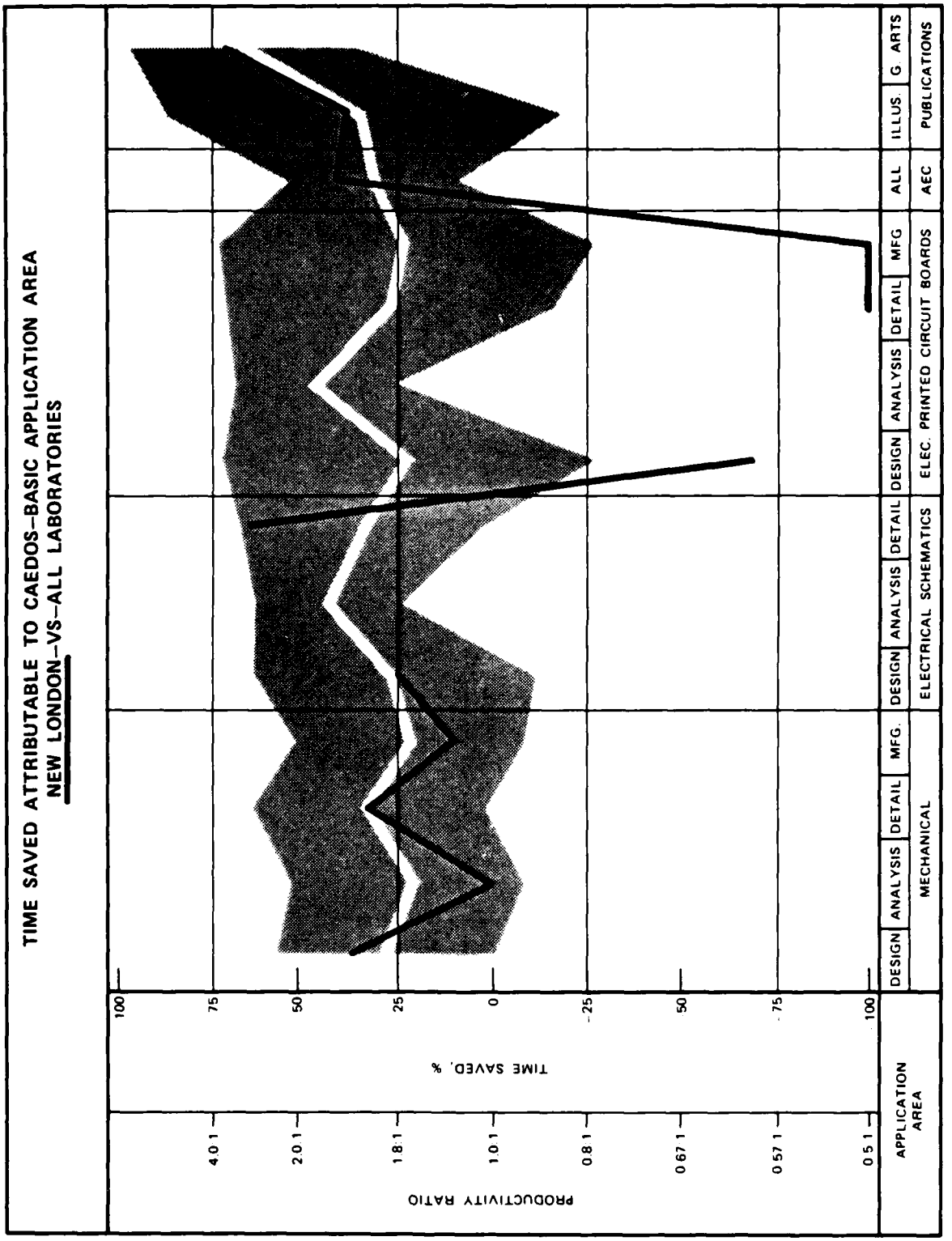

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
COMPOSITE ALL LABORATORIES
PRODUCTIVITY RATIO
4.01
2.01
1.81
1.01
0.81
0.671
0.571
0.51
TIME SAVED, %
100
75
50
25
0
25
50
75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS
PUBLICATIONS
G. ARTS

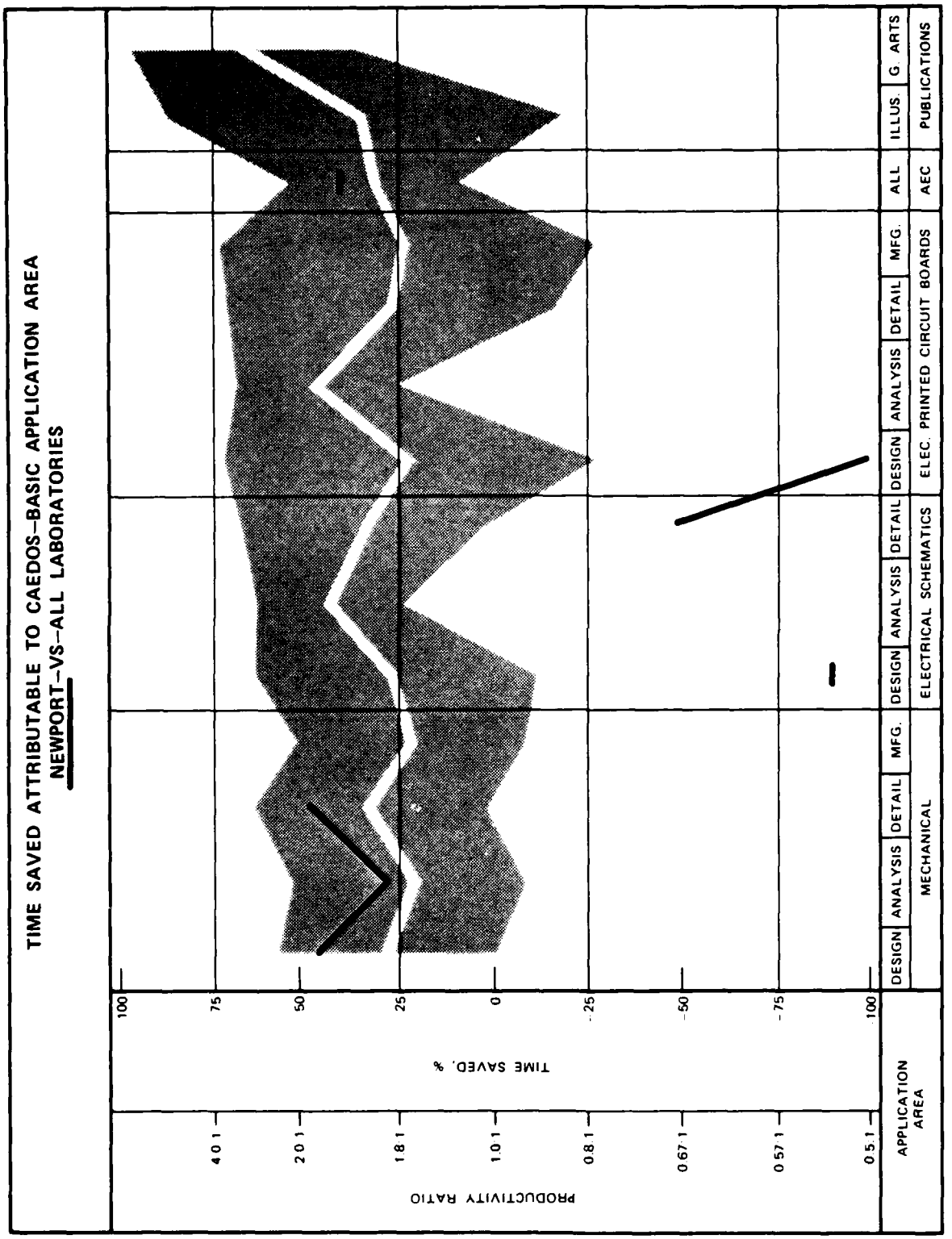

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
ANNAPOLIS–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4 0 1
2 0 1
1 8 1
1 0 1
0 8 1
0 6 7 1
0 5 7 1
0 5 1
TIME SAVED, %
100
75
50
25
0
25
50
75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS
G. ARTS
PUBLICATIONS

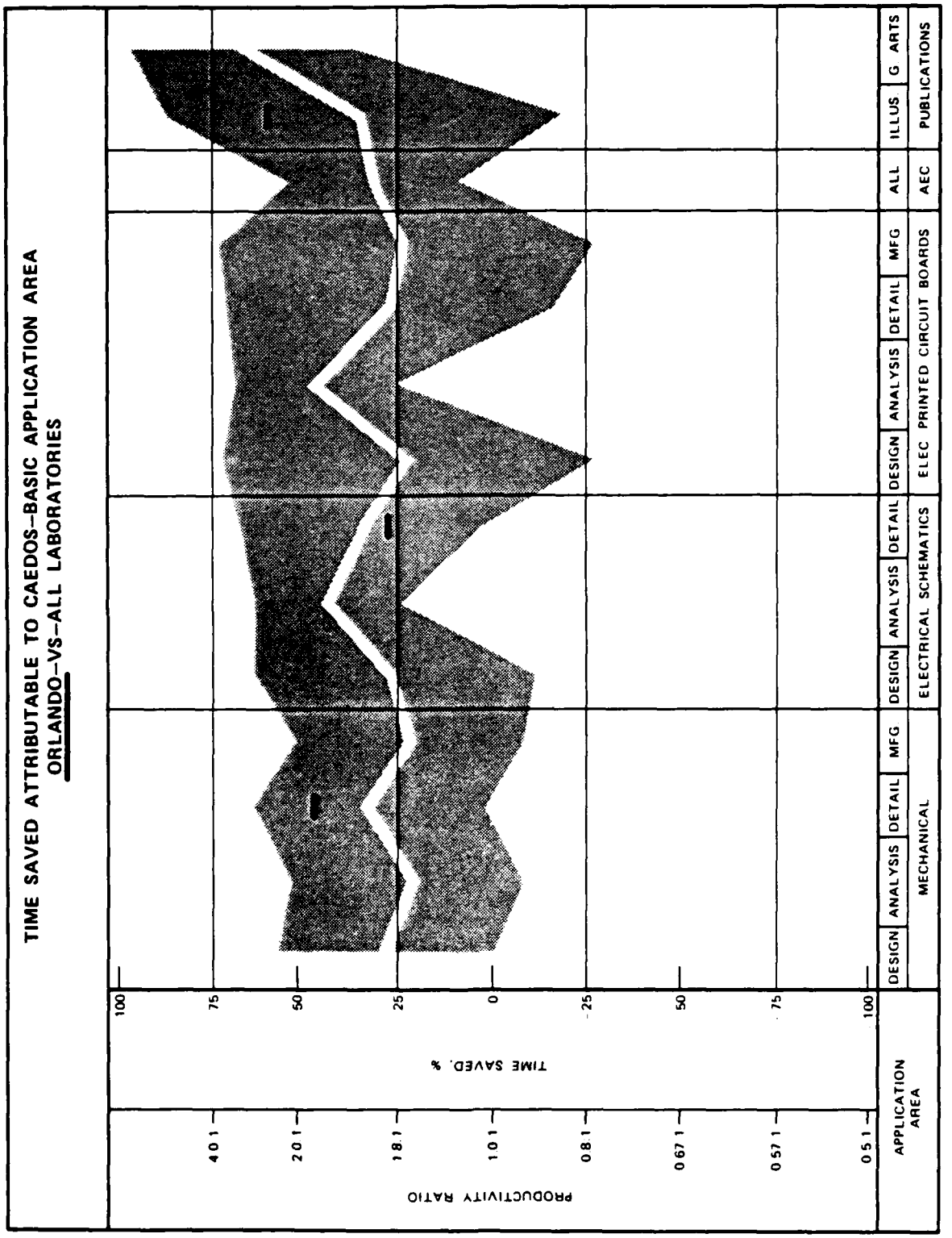

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
CHINA LAKE–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4 0 1
2 0 1
1 8 1
1 0 1
0 8 1
0 6 7 1
0 5 7 1
0 5 1
TIME SAVED, %
100
75
50
25
0
25
50
75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS
G. ARTS
PUBLICATIONS

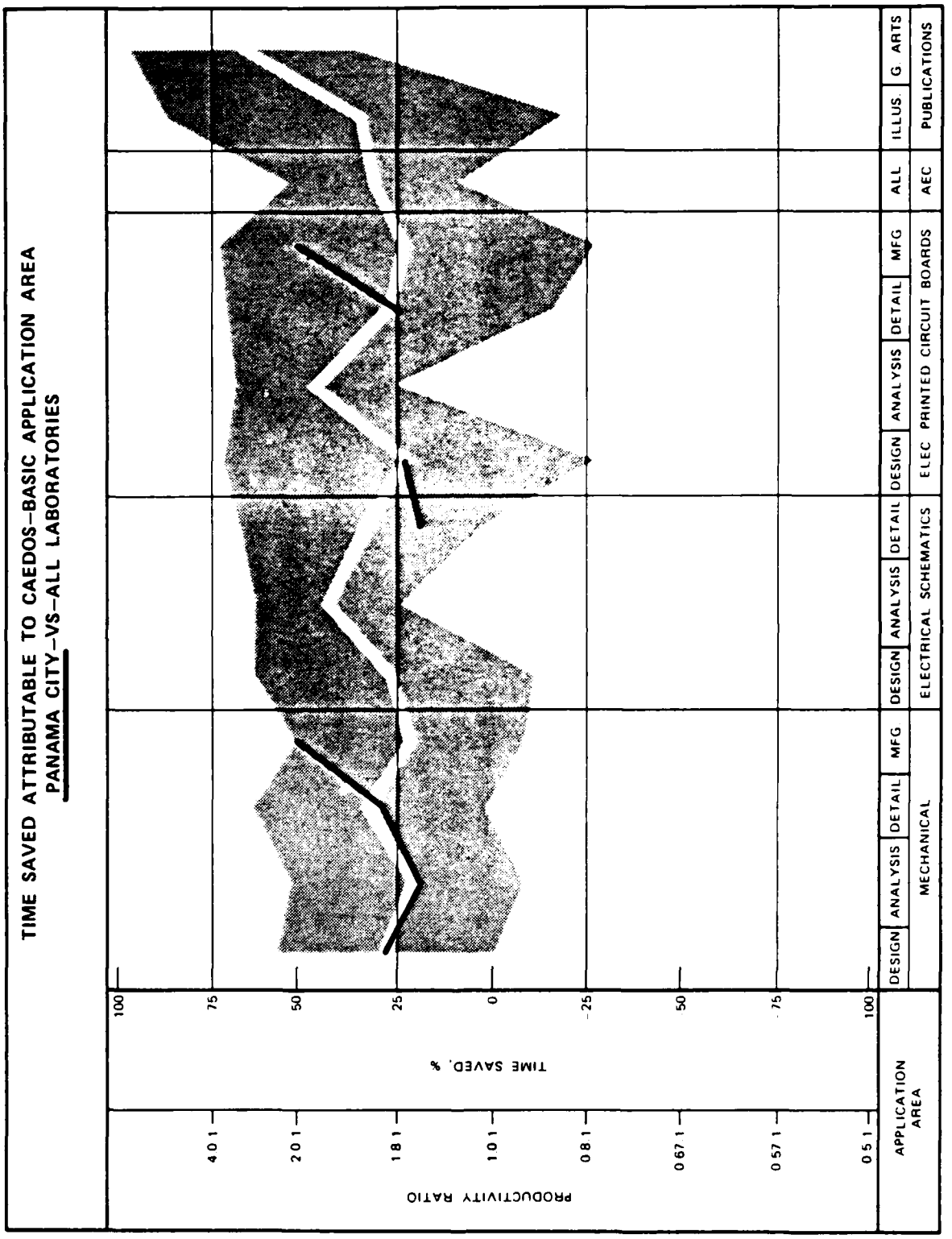

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
CARDEROCK–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4 0 1
2 0 1
1 8 1
1 0 1
0 8 1
0 6 7 1
0 5 7 1
0 5 1
TIME SAVED, %
100
75
50
25
0
-25
50
75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS

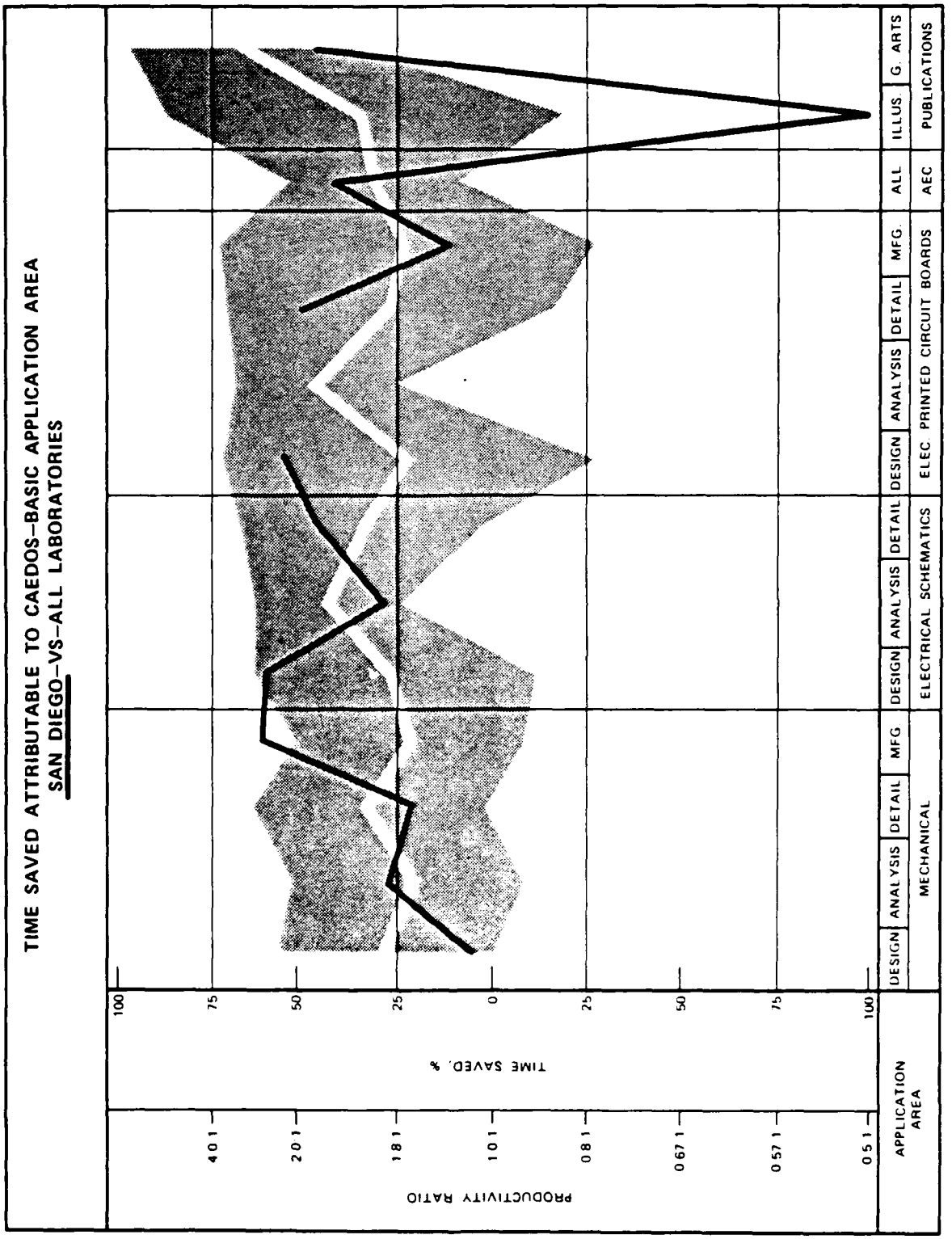

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
DAHLGREN–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4.0:1
2.0:1
1.8:1
1.0:1
0.8:1
0.67:1
0.57:1
0.5:1
TIME SAVED, %
100
75
50
25
0
-25
50
75
100
APPLICATION AREA
MECHANICAL
DESIGN
ANALYSIS
DETAIL
MFG.
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
ELEC. PRINTED CIRCUIT BOARDS
DESIGN
ANALYSIS
DETAIL
MFG.
AEC
ALL
PUBLICATIONS
ILLUS
G ARTS

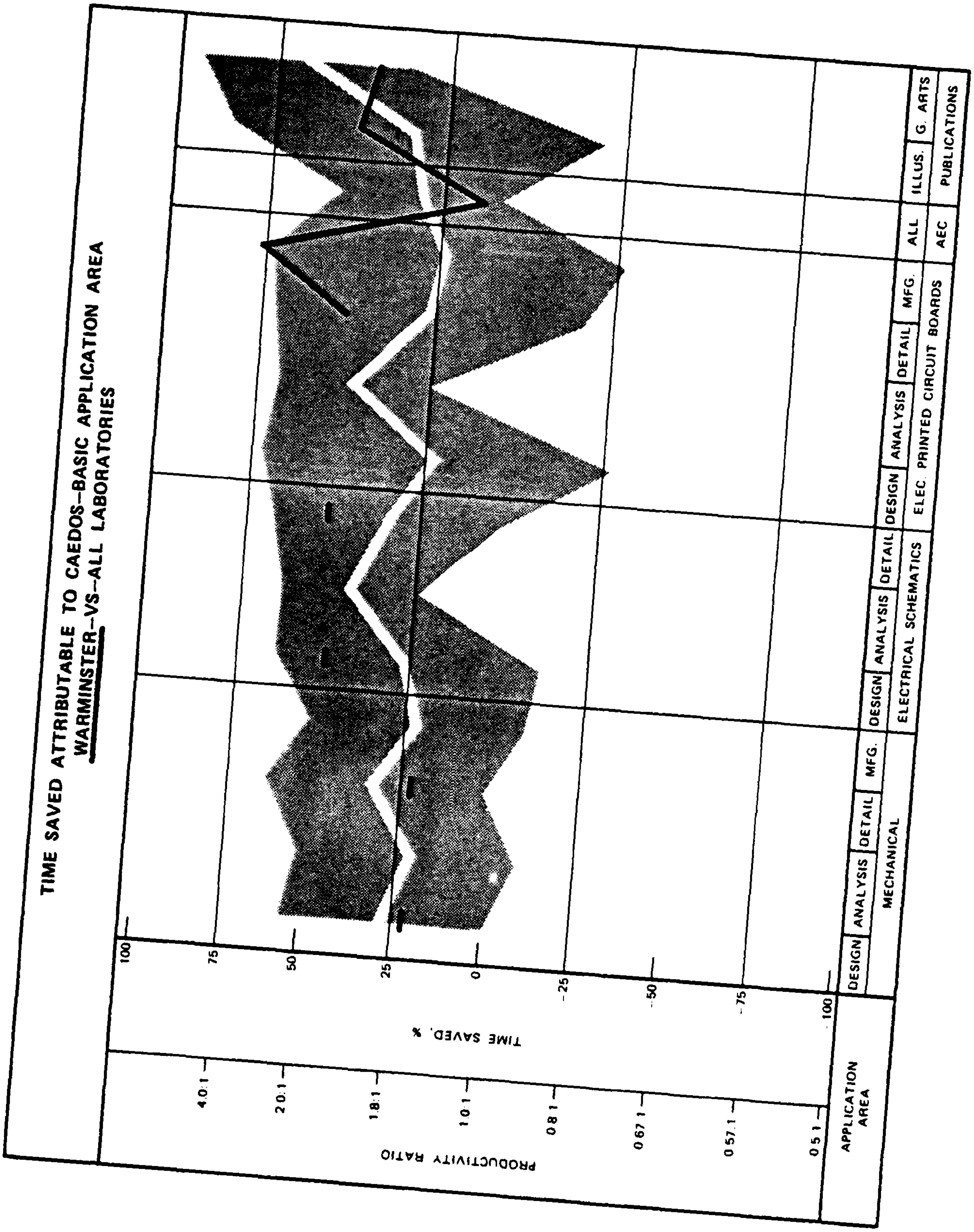

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
NEW LONDON–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4.0:1
2.0:1
1.8:1
1.0:1
0.8:1
0.67:1
0.57:1
0.5:1
TIME SAVED, %
100
75
50
25
0
-25
50
75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
DESIGN
ANALYSIS
DETAIL
DESIGN
ANALYSIS
DETAIL
MFG
ALL
ILLUS
G ARTS
MECHANICAL
ELECTRICAL SCHEMATICS
ELEC. PRINTED CIRCUIT BOARDS
AEC
PUBLICATIONS

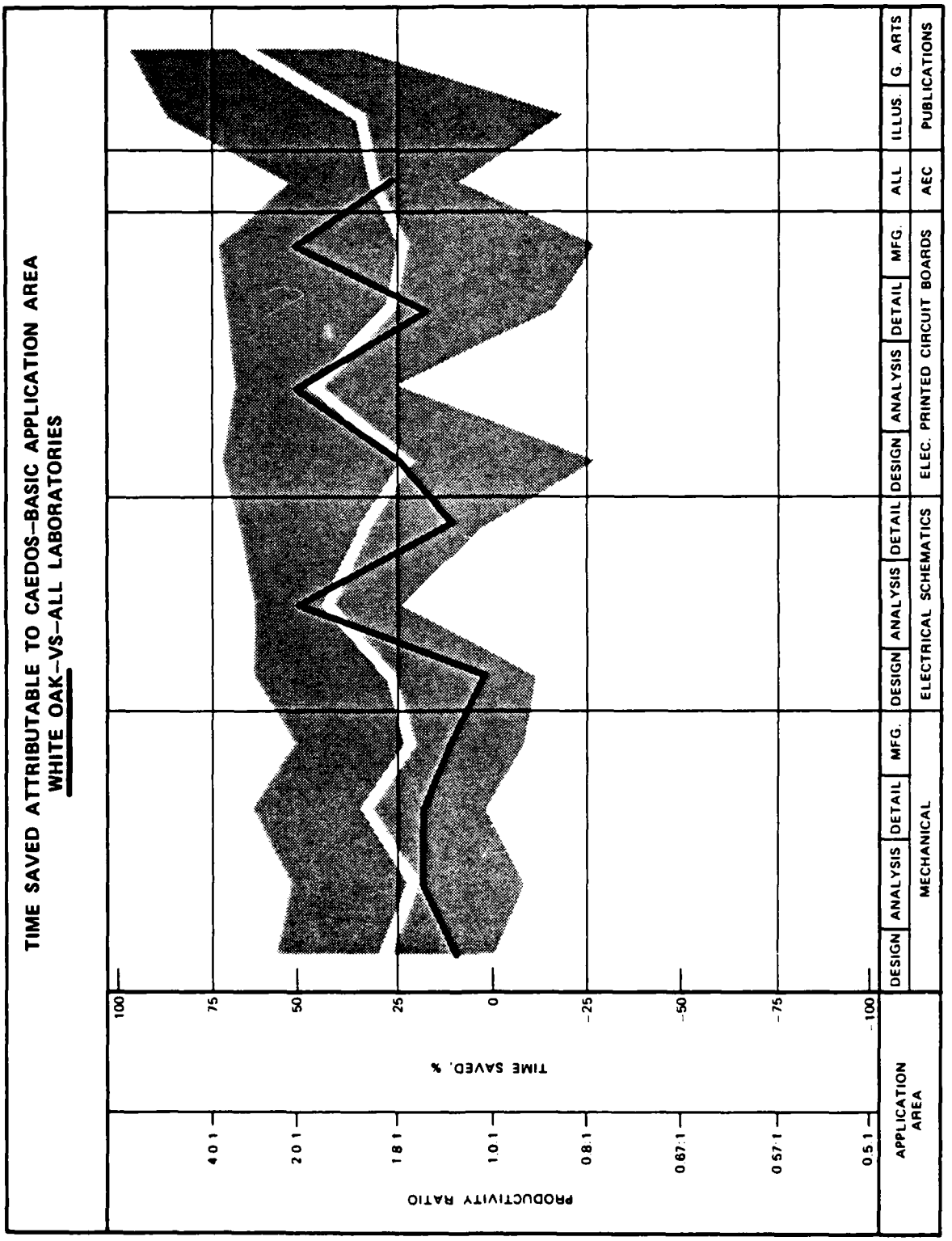

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
NEWPORT–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4.0:1
2.0:1
1.8:1
1.0:1
0.8:1
0.67:1
0.57:1
0.5:1
TIME SAVED, %
100
75
50
25
0
-25
-50
-75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G ARTS
PUBLICATIONS


TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
ORLANDO–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4.0:1
2.0:1
1.8:1
1.0:1
0.8:1
0.67:1
0.57:1
0.5:1
TIME SAVED, %
100
75
50
25
0
-25
50
75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS
G ARTS
PUBLICATIONS


TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
PANAMA CITY–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4 0 1
2 0 1
1 8 1
1 0 1
0 8 1
0 6 7 1
0 5 7 1
0 5 1
TIME SAVED, %
100
75
50
25
0
-25
50
75
100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS
G ARTS
PUBLICATIONS

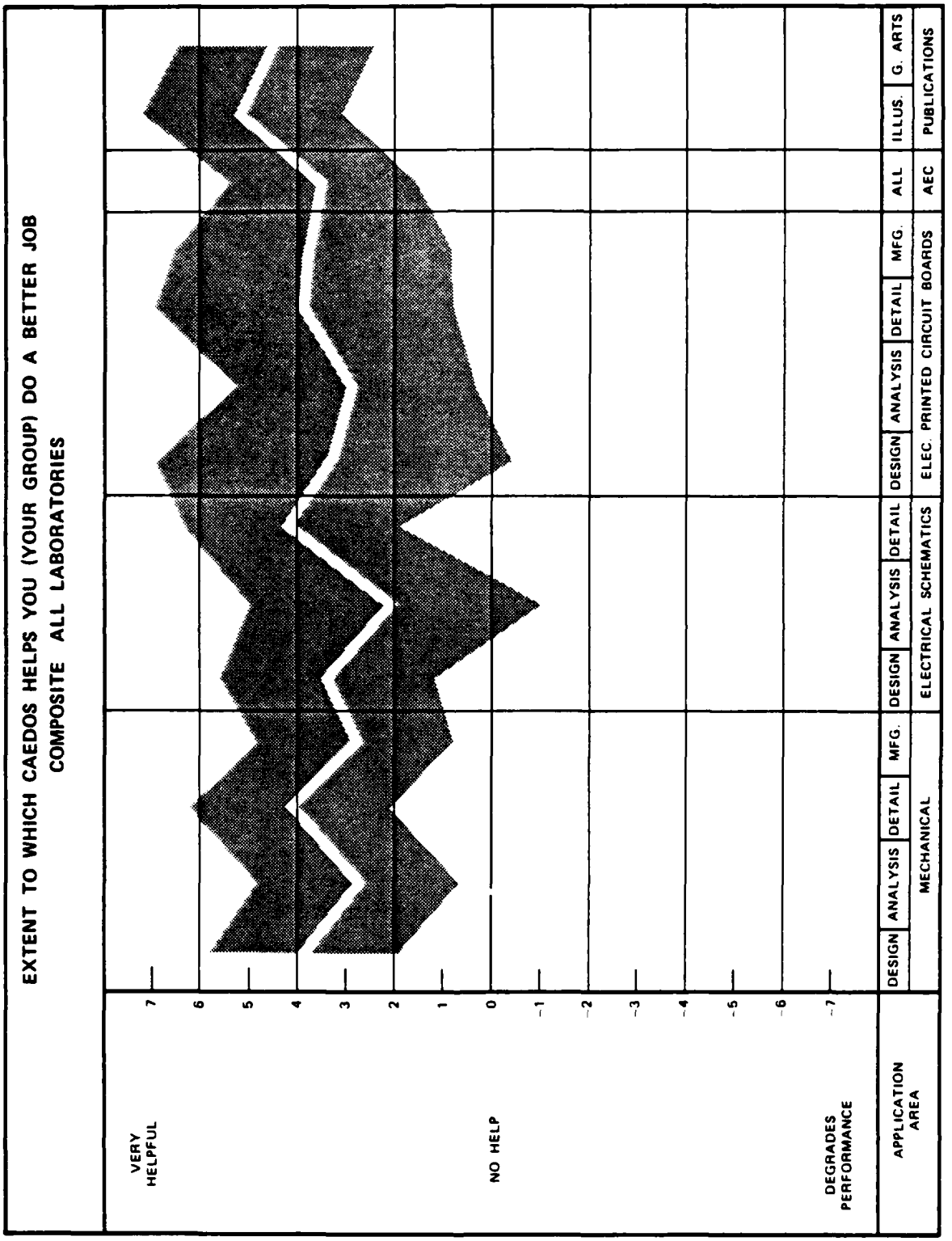

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
SAN DIEGO–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4.0 1
2.0 1
1.8 1
1.0 1
0.8 1
0.67 1
0.57 1
0.5 1
TIME SAVED, %
100
75
50
25
0
25
50
75
100
APPLICATION AREA
MECHANICAL
ELECTRICAL SCHEMATICS
ELEC. PRINTED CIRCUIT BOARDS
DESIGN
ANALYSIS
DETAIL
MFG
DESIGN
ANALYSIS
DETAIL
DESIGN
ANALYSIS
DETAIL
MFG.
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS

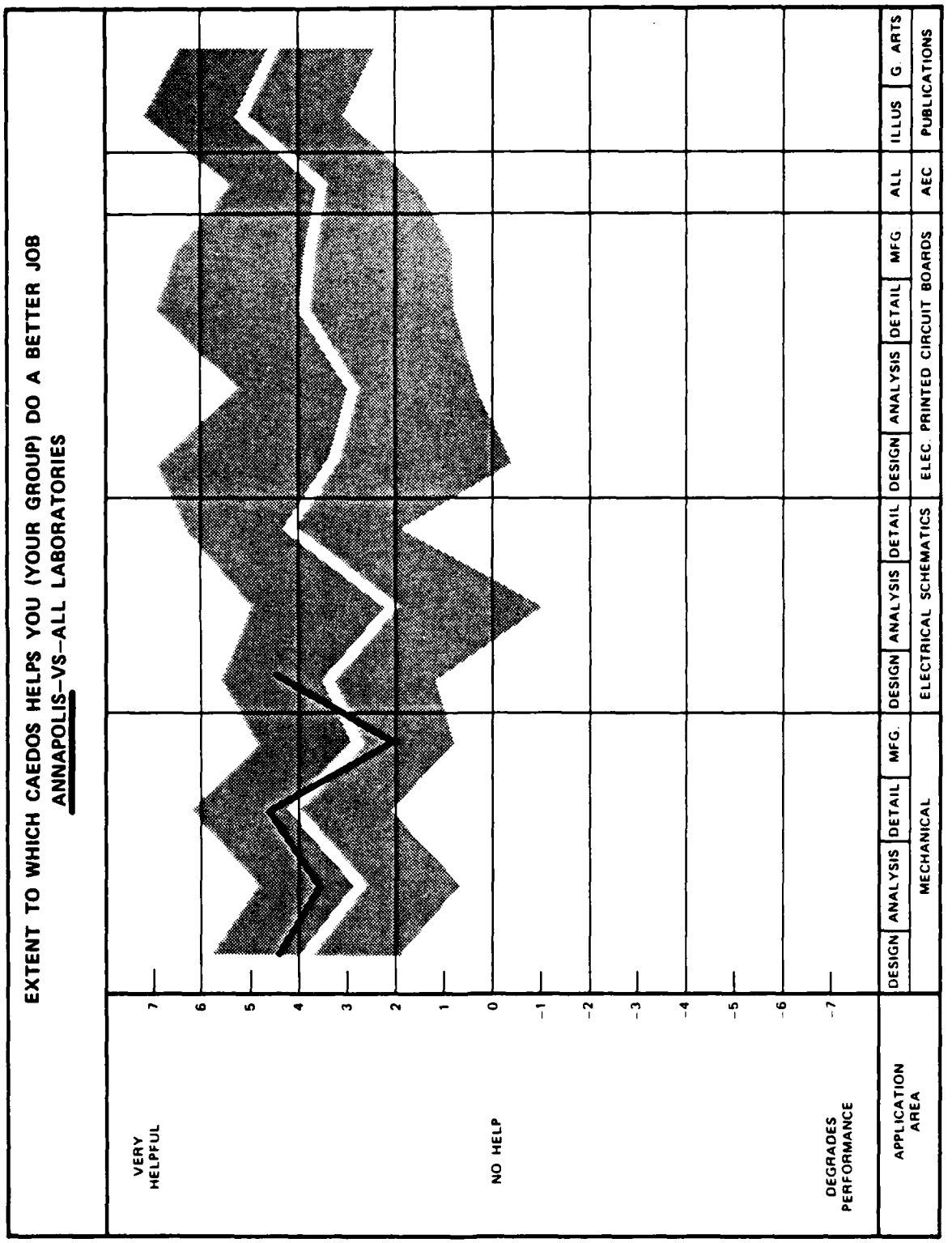

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
WARMINSTER–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4.0:1
2.0:1
1.8:1
1.0:1
0.8:1
0.67:1
0.57:1
0.5:1
TIME SAVED, %
100
75
50
25
0
-25
-50
-75
-100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS

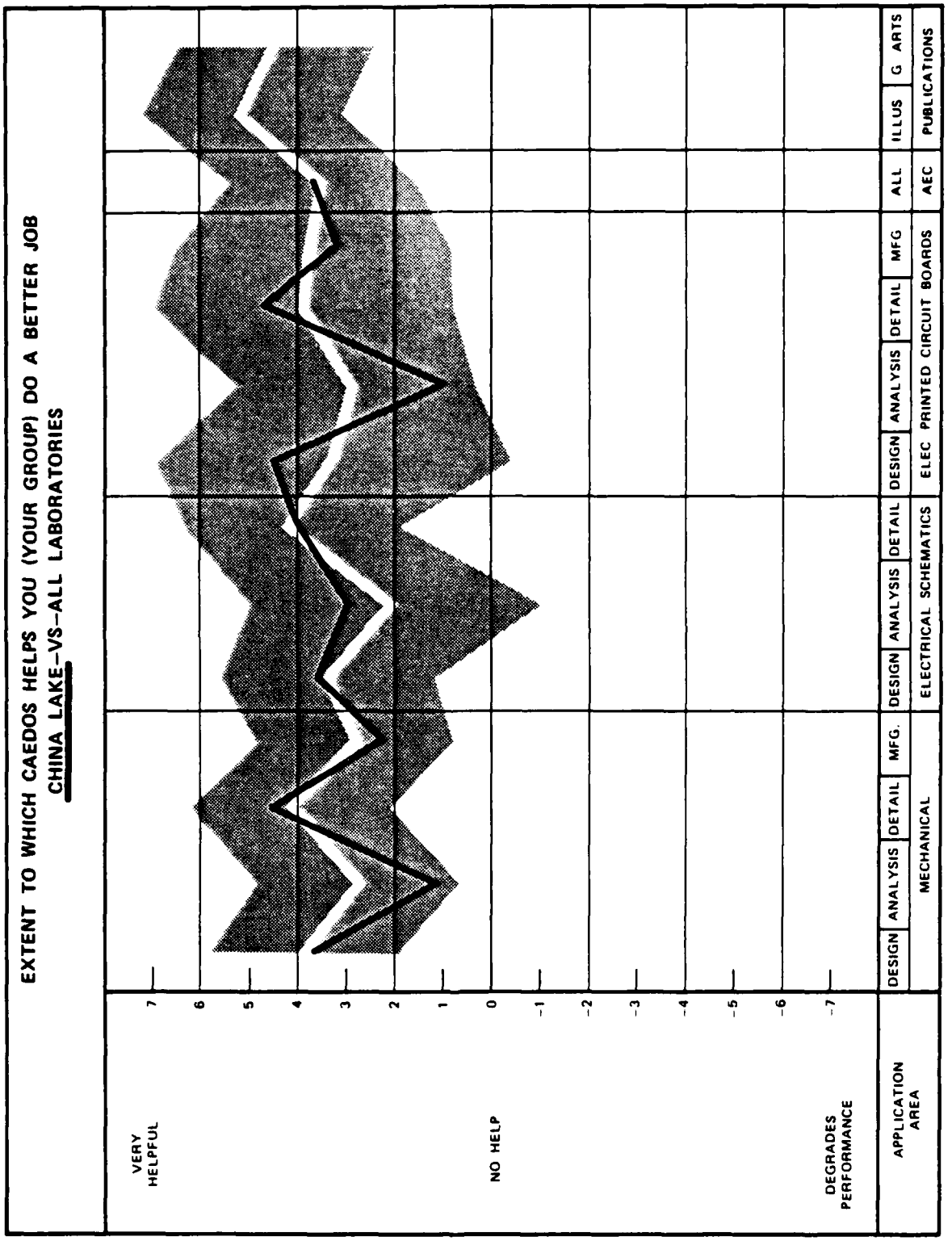

TIME SAVED ATTRIBUTABLE TO CAEDOS–BASIC APPLICATION AREA
WHITE OAK–VS–ALL LABORATORIES
PRODUCTIVITY RATIO
4:1
2:1
1:8:1
1:0:1
0:8:1
0:67:1
0:57:1
0:5:1
TIME SAVED, %
100
75
50
25
0
-25
-50
-75
-100
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
PUBLICATIONS
ILLUS.
G. ARTS

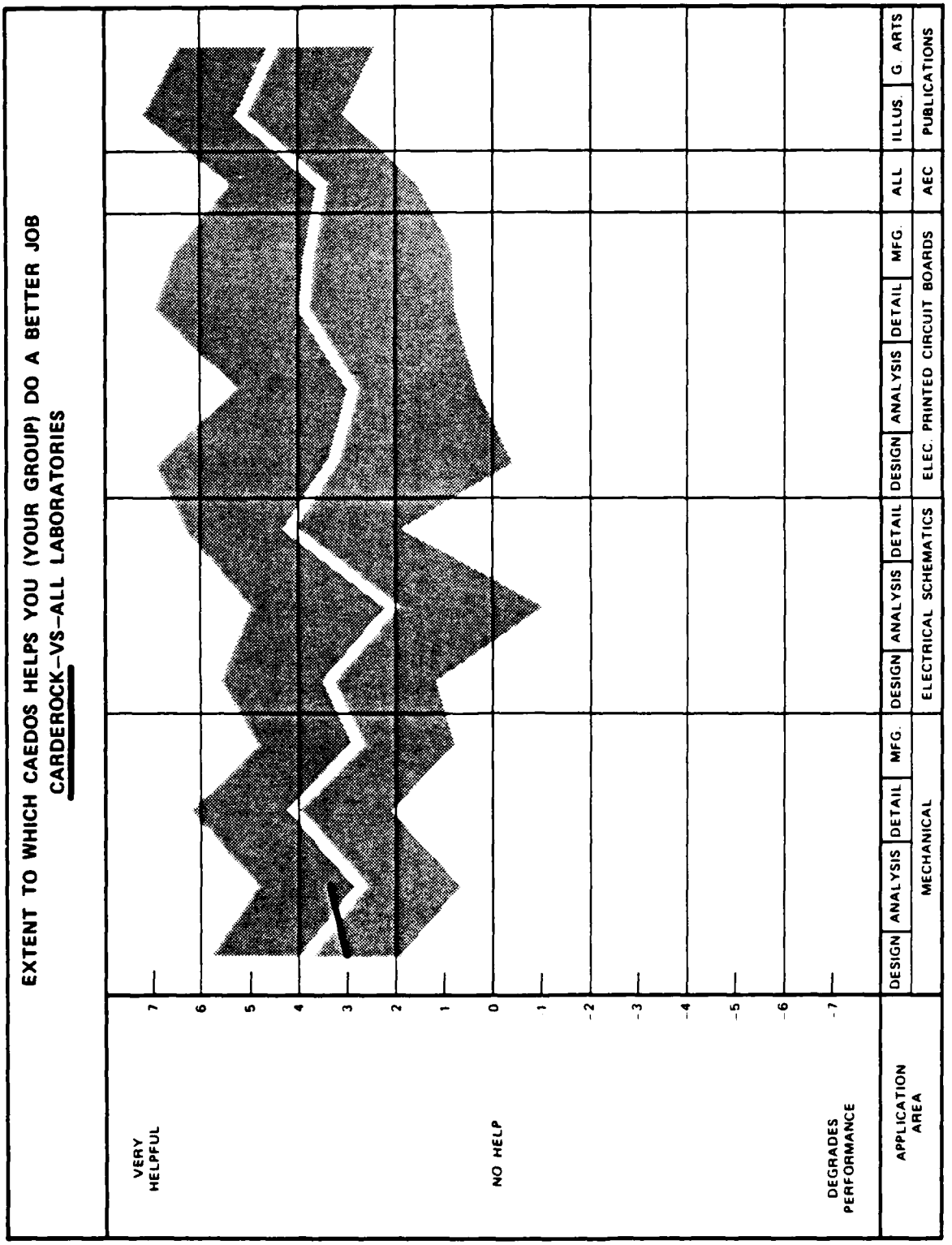
Appendix L

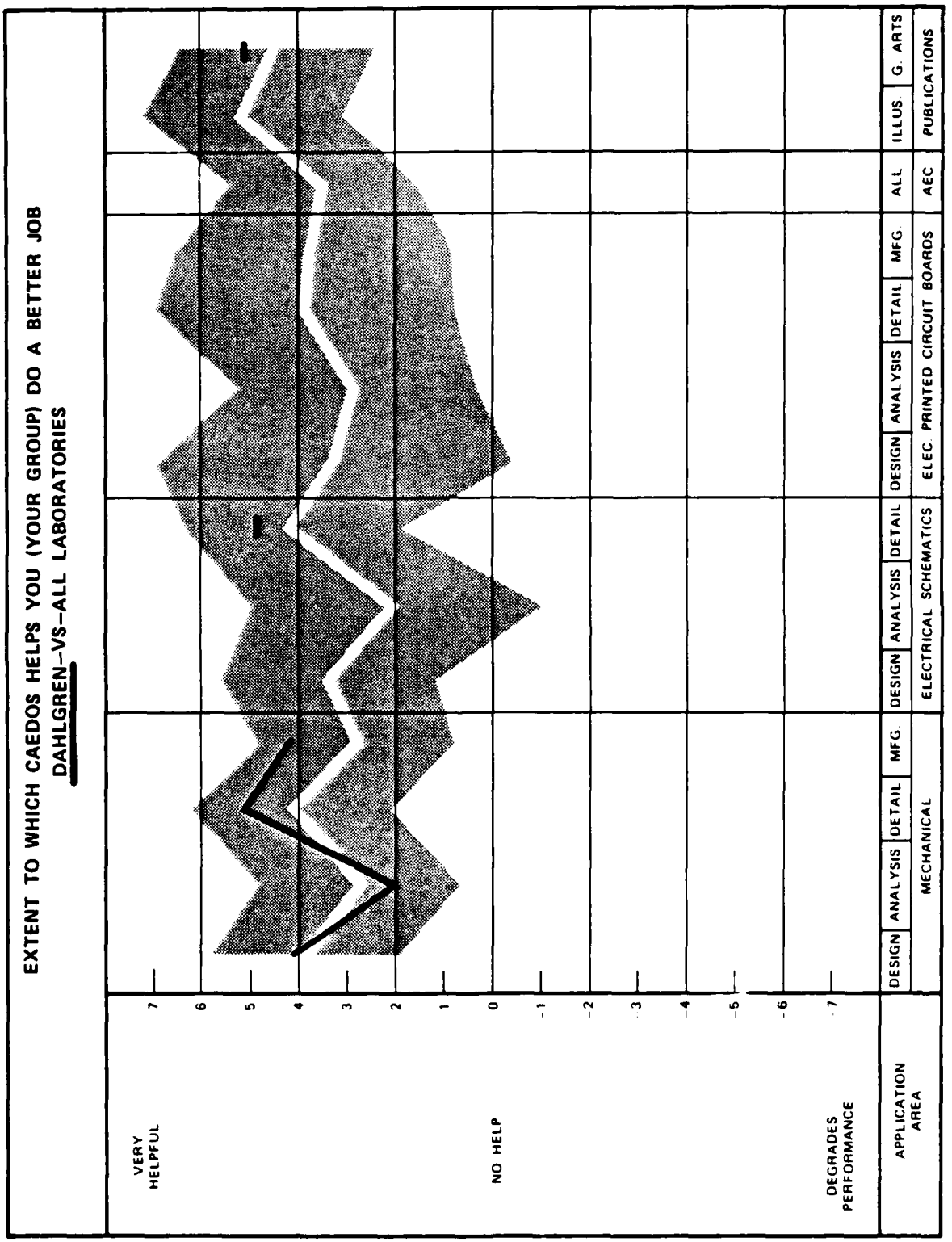
EXTENT TO WHICH CAEDOS HELPED USERS DO A BETTER JOB

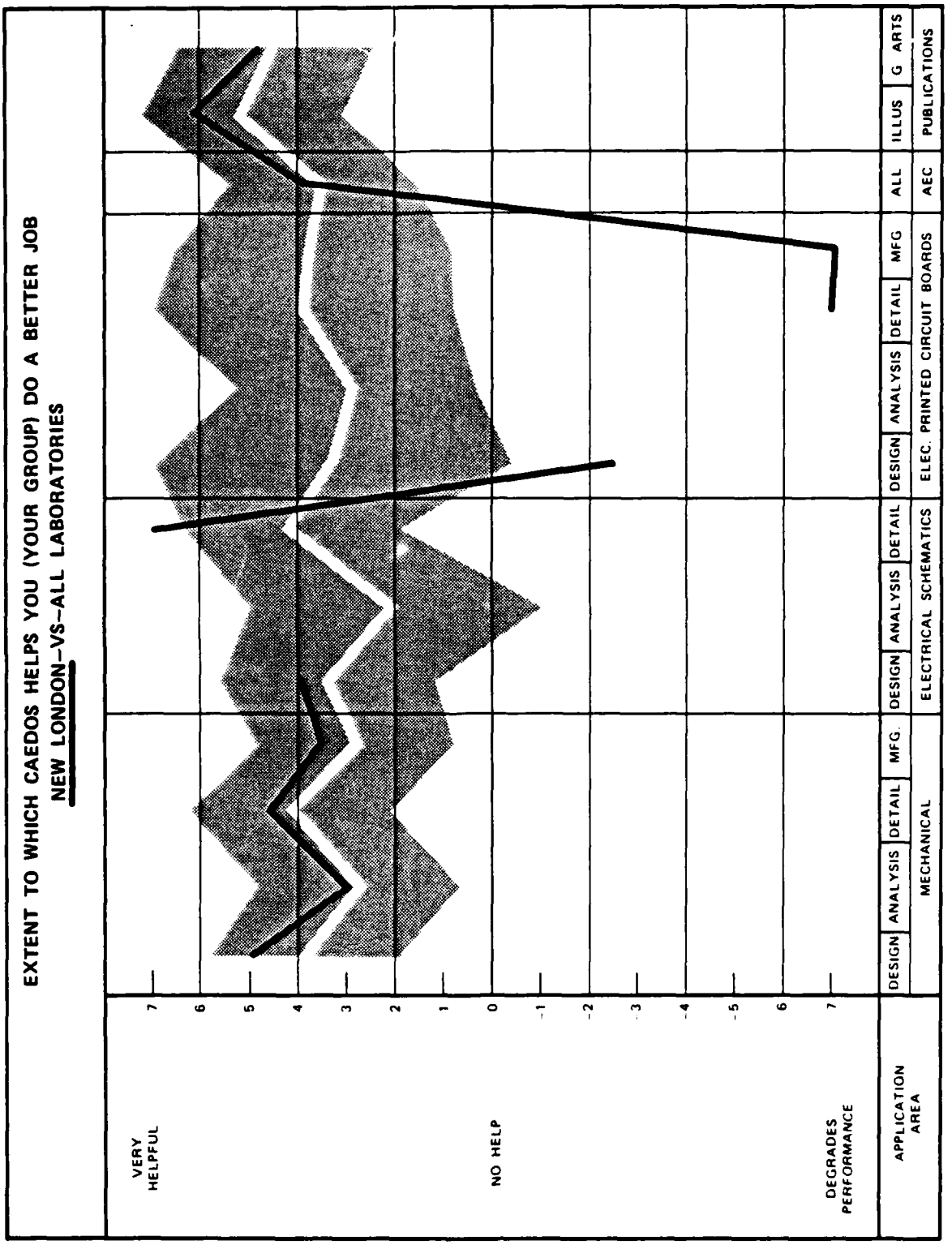

EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
COMPOSITE ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
APPLICATION AREA
MECHANICAL
ELECTRICAL SCHEMATICS
ELEC. PRINTED CIRCUIT BOARDS
AEC
PUBLICATIONS
DESIGN
ANALYSIS
DETAIL
MFG.
ILLUS.
G. ARTS
ALL


EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
ANNAPOLIS–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
7
6
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
APPLICATION AREA
MECHANICAL
ELECTRICAL SCHEMATICS
ELEC. PRINTED CIRCUIT BOARDS
AEC
PUBLICATIONS
DESIGN
ANALYSIS
DETAIL
MFG.
ILLUS
G. ARTS
ALL


EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
CHINA LAKE-VS-ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS
PUBLICATIONS
G ARTS


EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
CARDEROCK–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS


EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
DAHLGREN–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS
G. ARTS
PUBLICATIONS


EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
NEW LONDON–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
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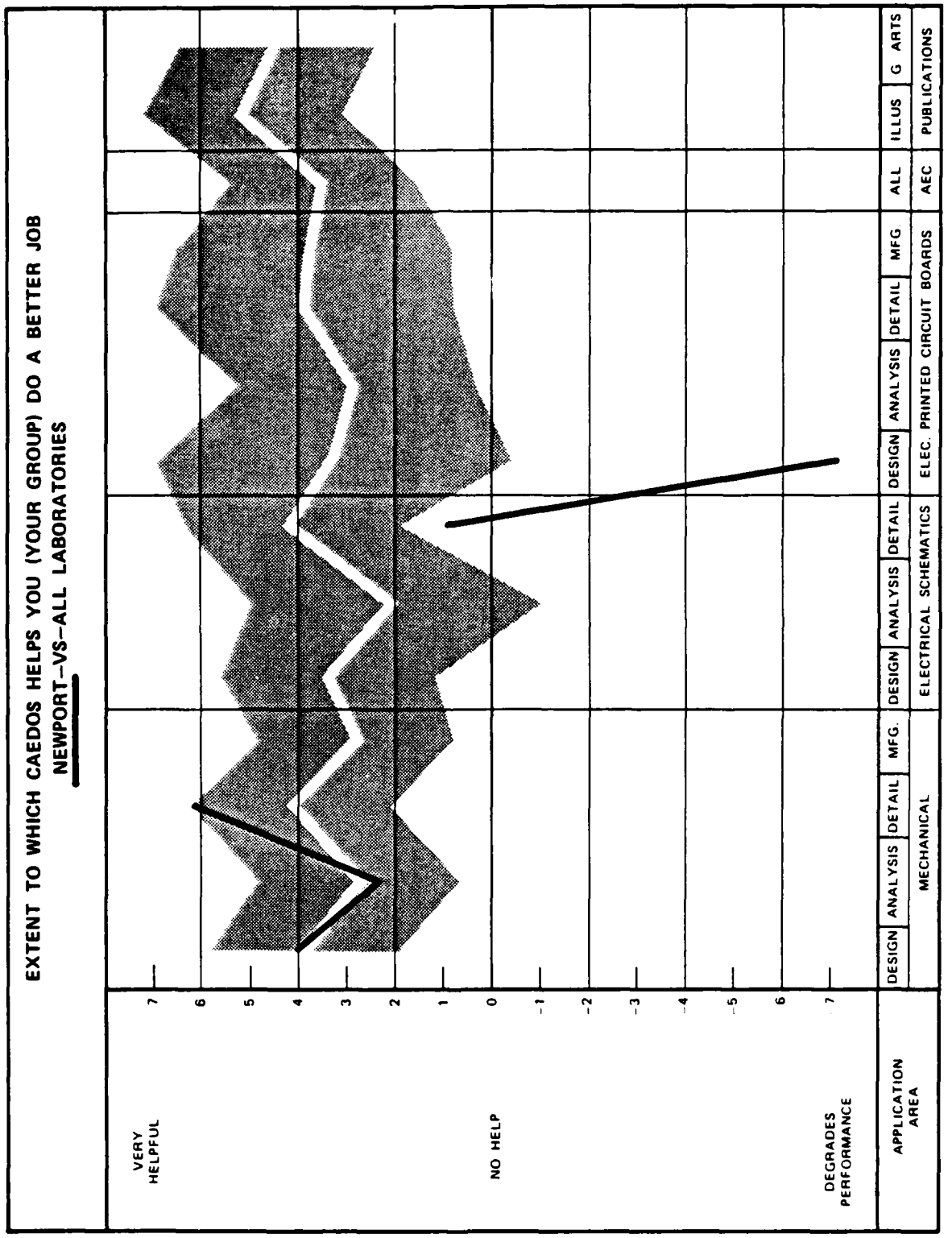
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VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
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APPLICATION AREA
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ELEC. PRINTED CIRCUIT BOARDS
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ILLUS
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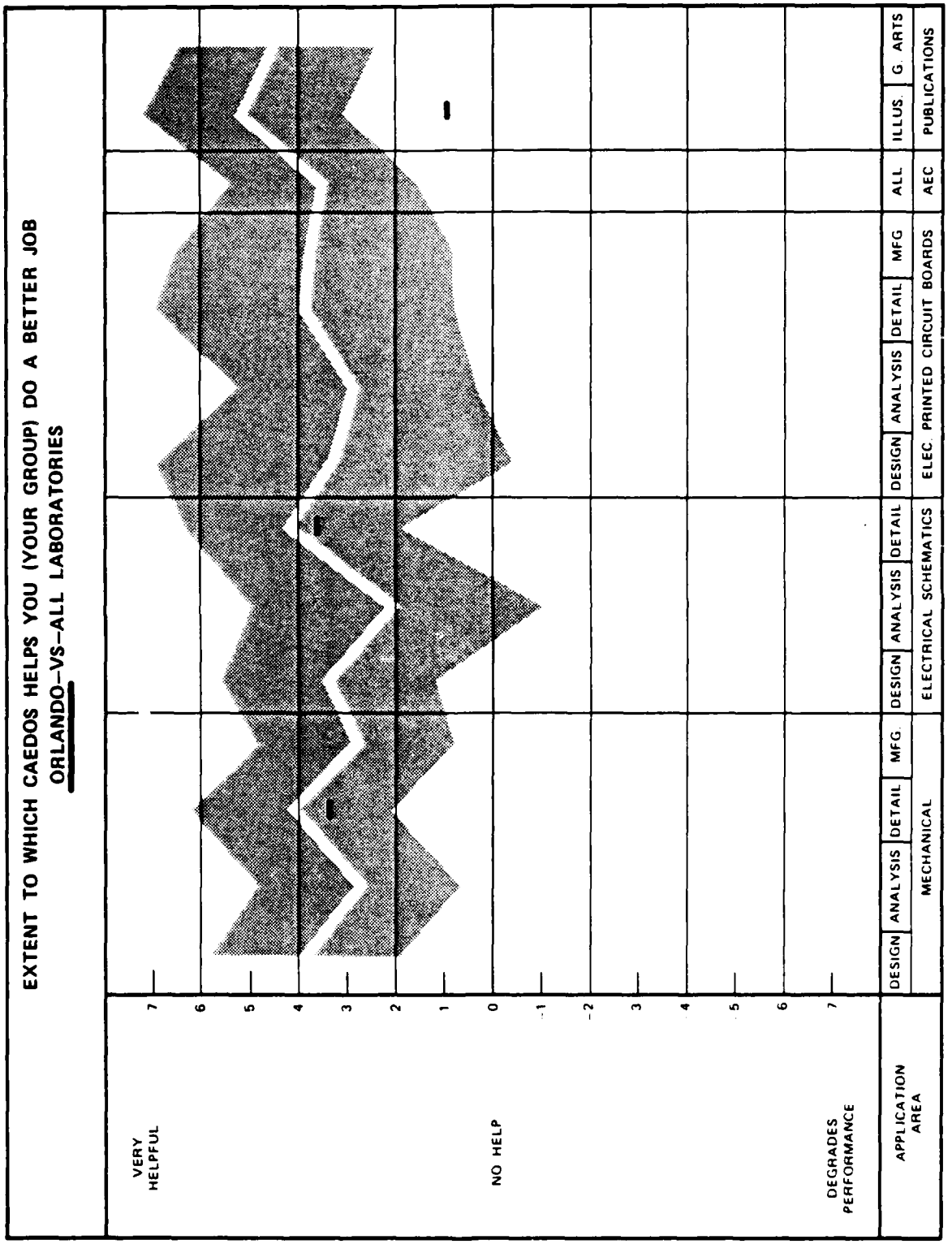
PUBLICATIONS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ORLANDO-VS-ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
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APPLICATION AREA
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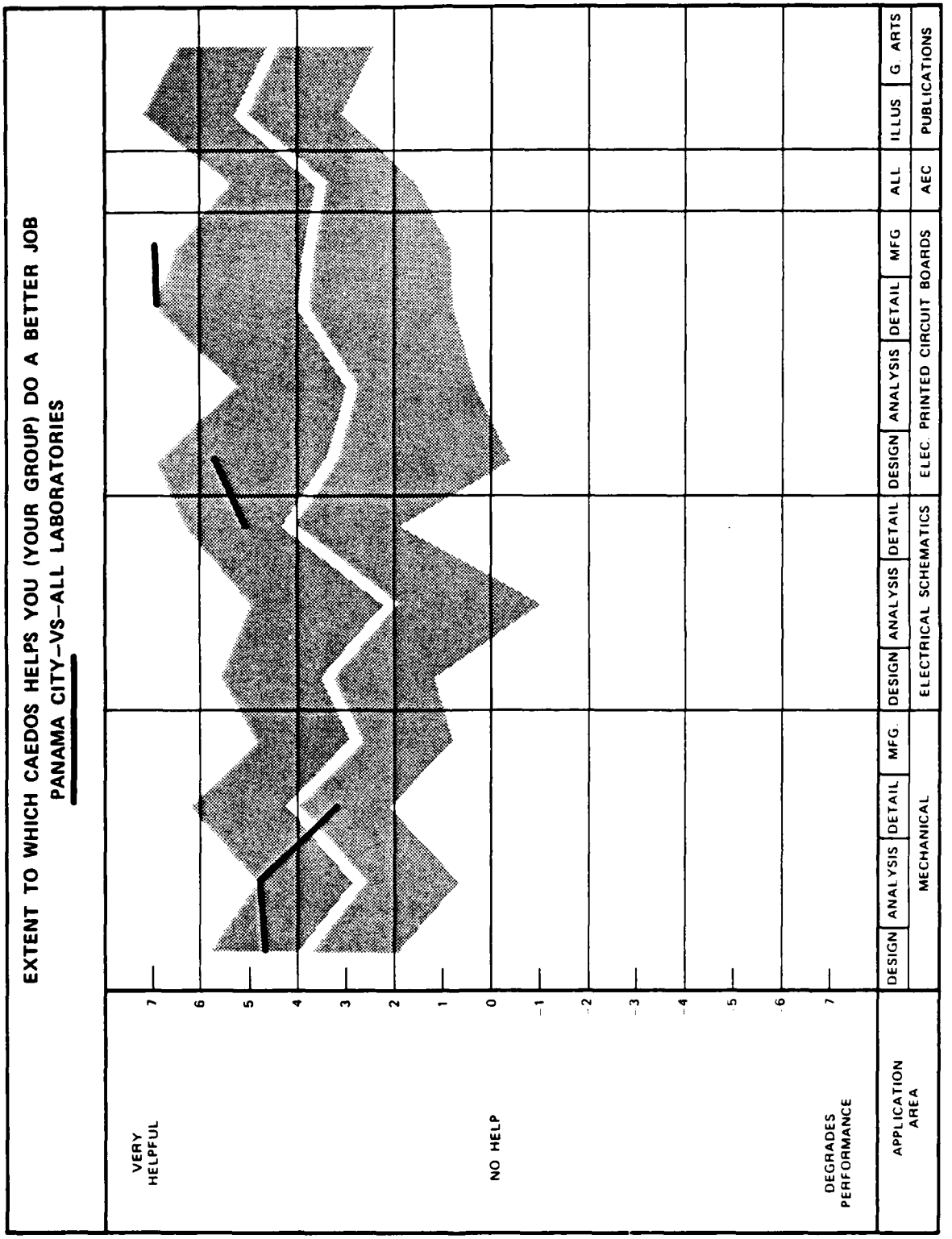
PUBLICATIONS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PANAMA CITY–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
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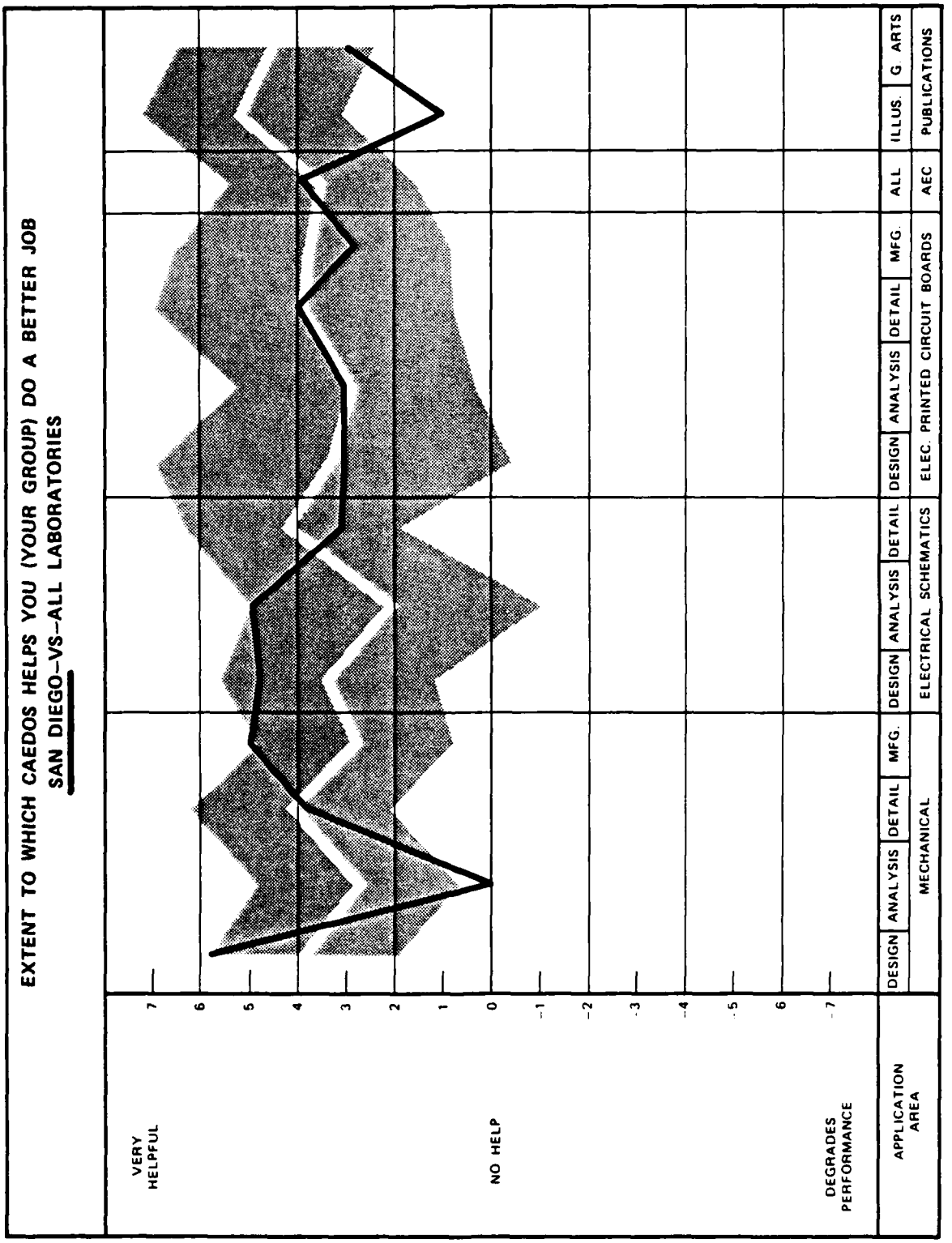
PUBLICATIONS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SAN DIEGO–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
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ELECTRICAL SCHEMATICS
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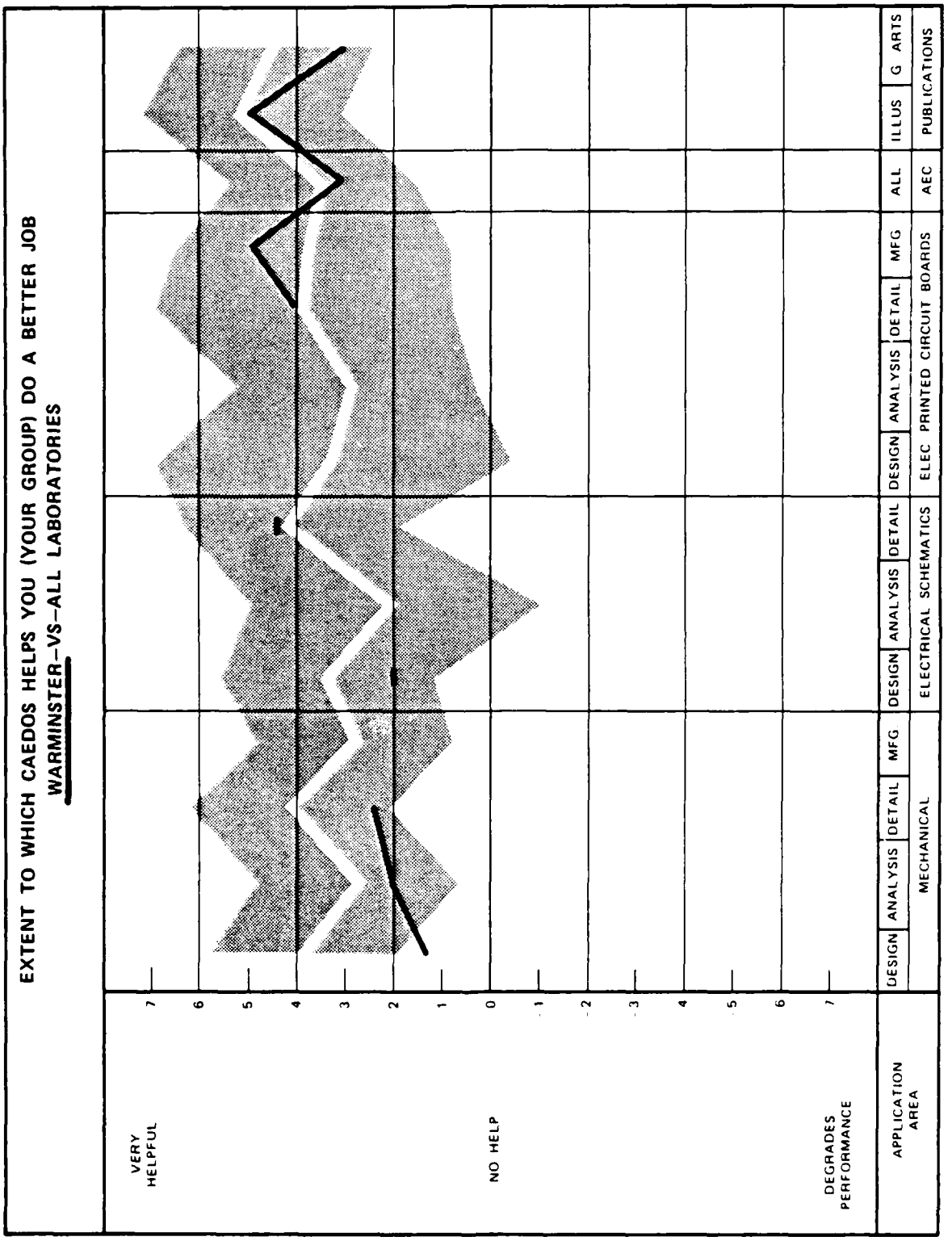
G. ARTS
PUBLICATIONS


EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
WARMINSTER–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
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APPLICATION AREA
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DETAIL
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MECHANICAL
DESIGN
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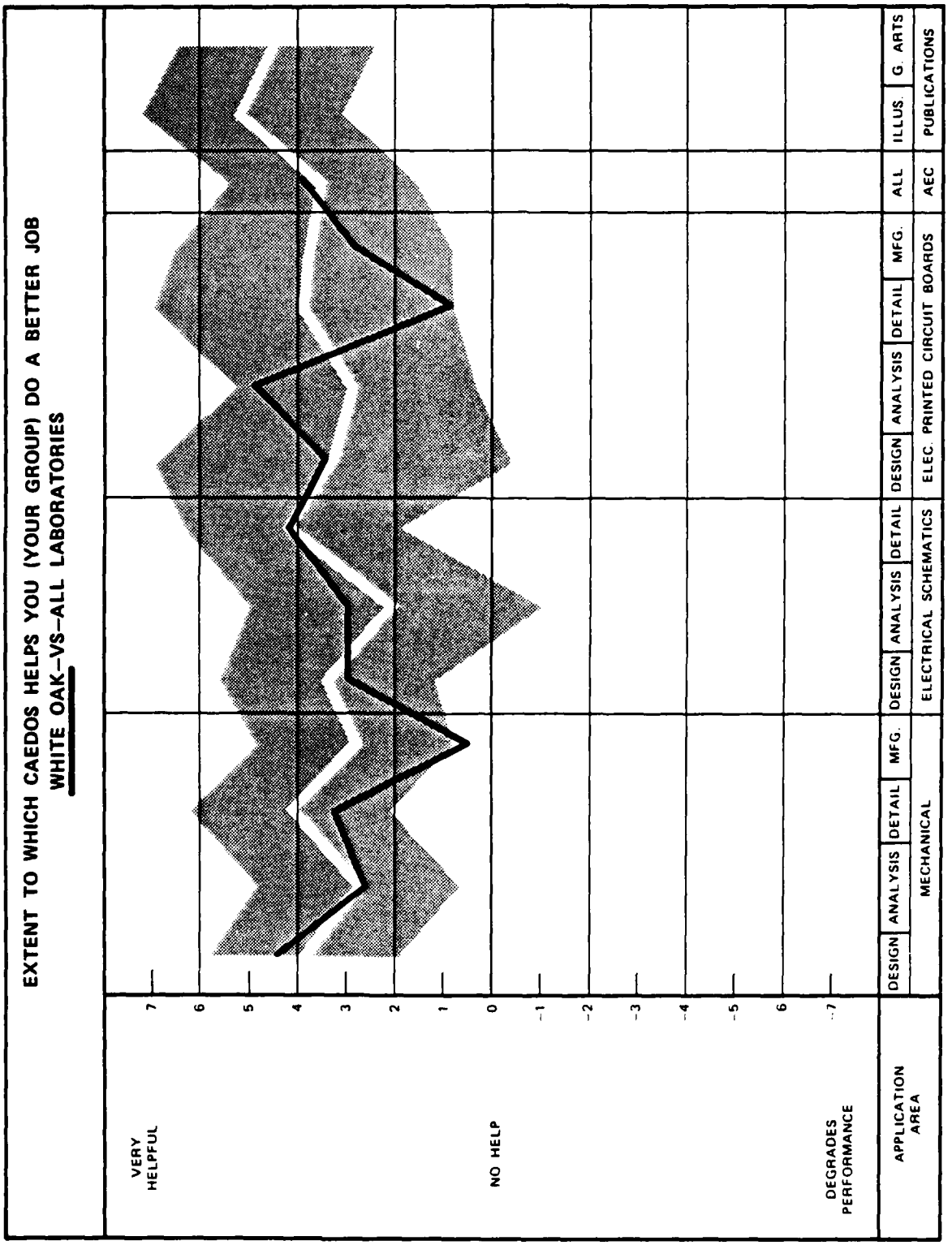
PUBLICATIONS


EXTENT TO WHICH CAEDOS HELPS YOU (YOUR GROUP) DO A BETTER JOB
WHITE OAK–VS–ALL LABORATORIES
VERY HELPFUL
NO HELP
DEGRADES PERFORMANCE
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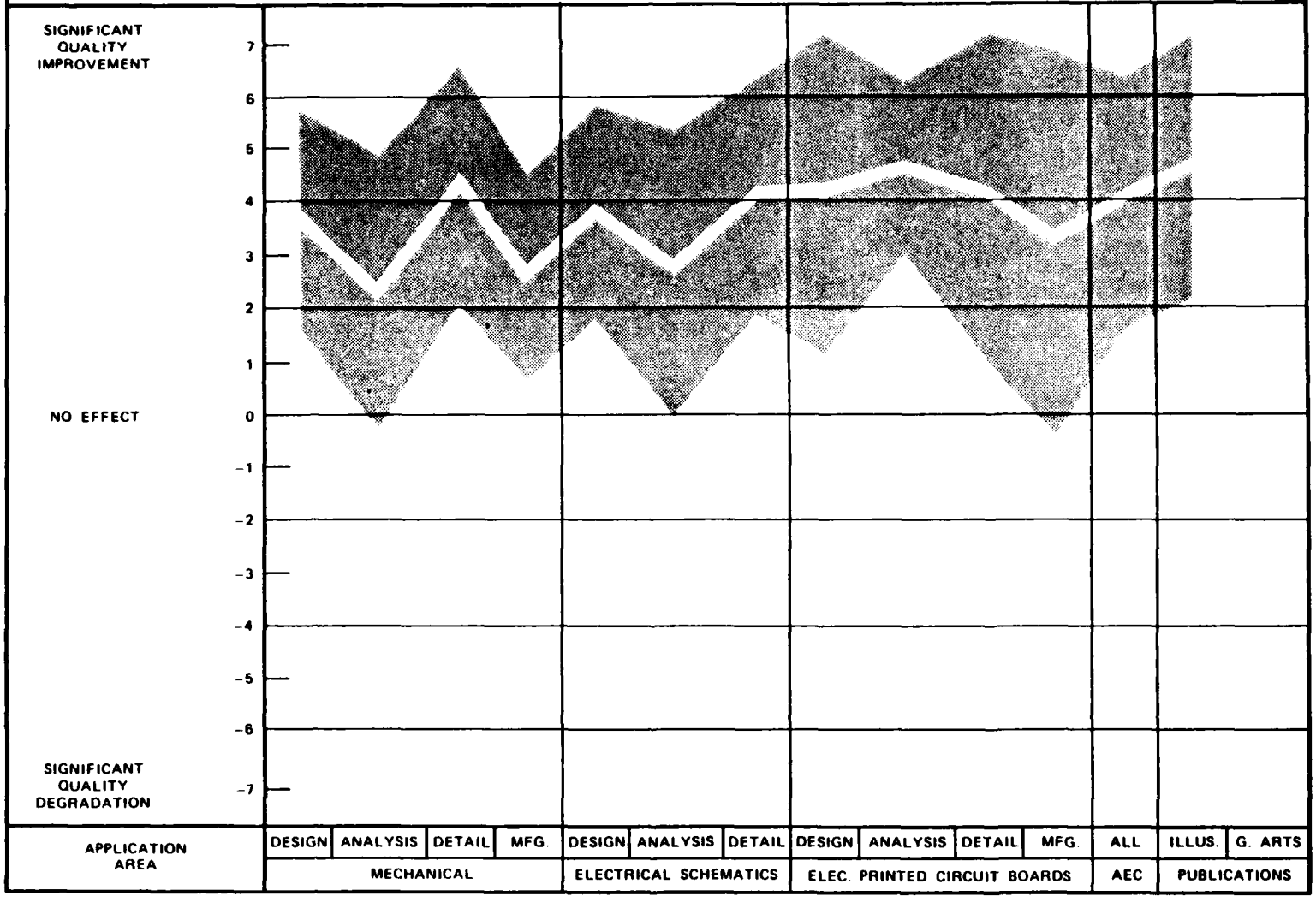
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG.
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS

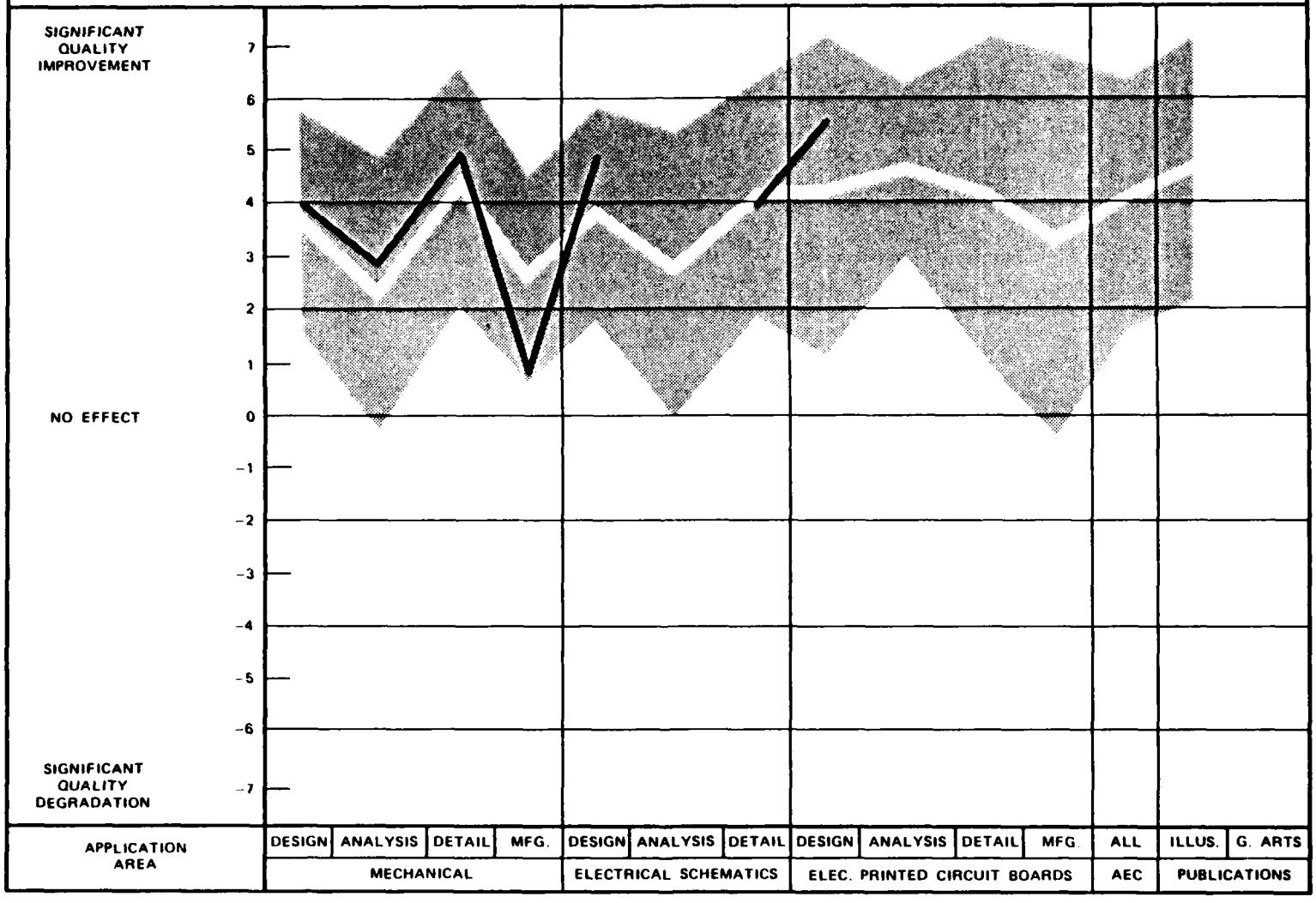
Appendix M

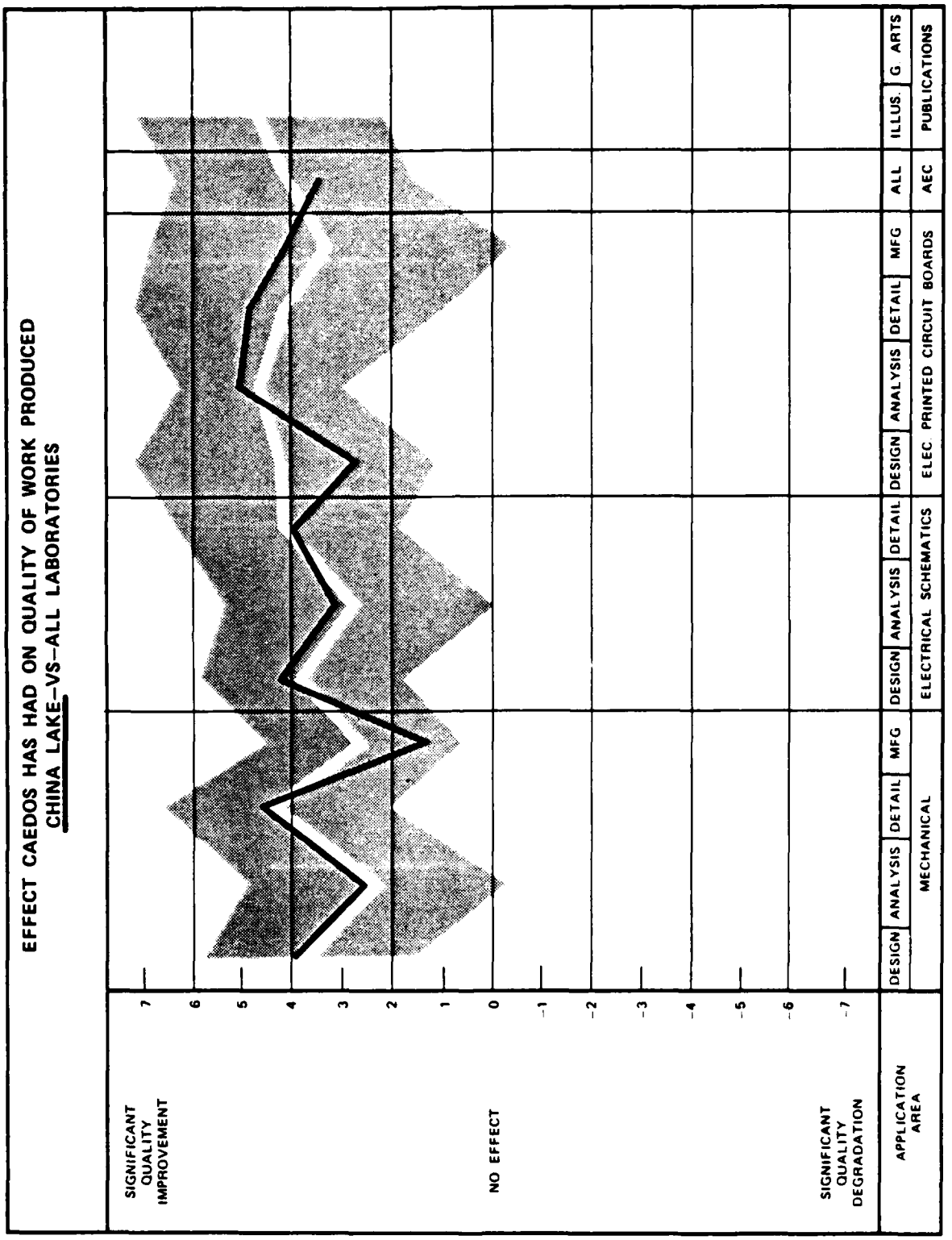
IMPROVEMENT IN QUALITY OF WORK ATTRIBUTABLE TO CAEDOS

EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
COMPOSITE ALL LABORATORIES



EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
ANNAPOLIS–VS–ALL LABORATORIES




EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
CHINA LAKE–VS–ALL LABORATORIES
SIGNIFICANT QUALITY IMPROVEMENT
NO EFFECT
SIGNIFICANT QUALITY DEGRADATION
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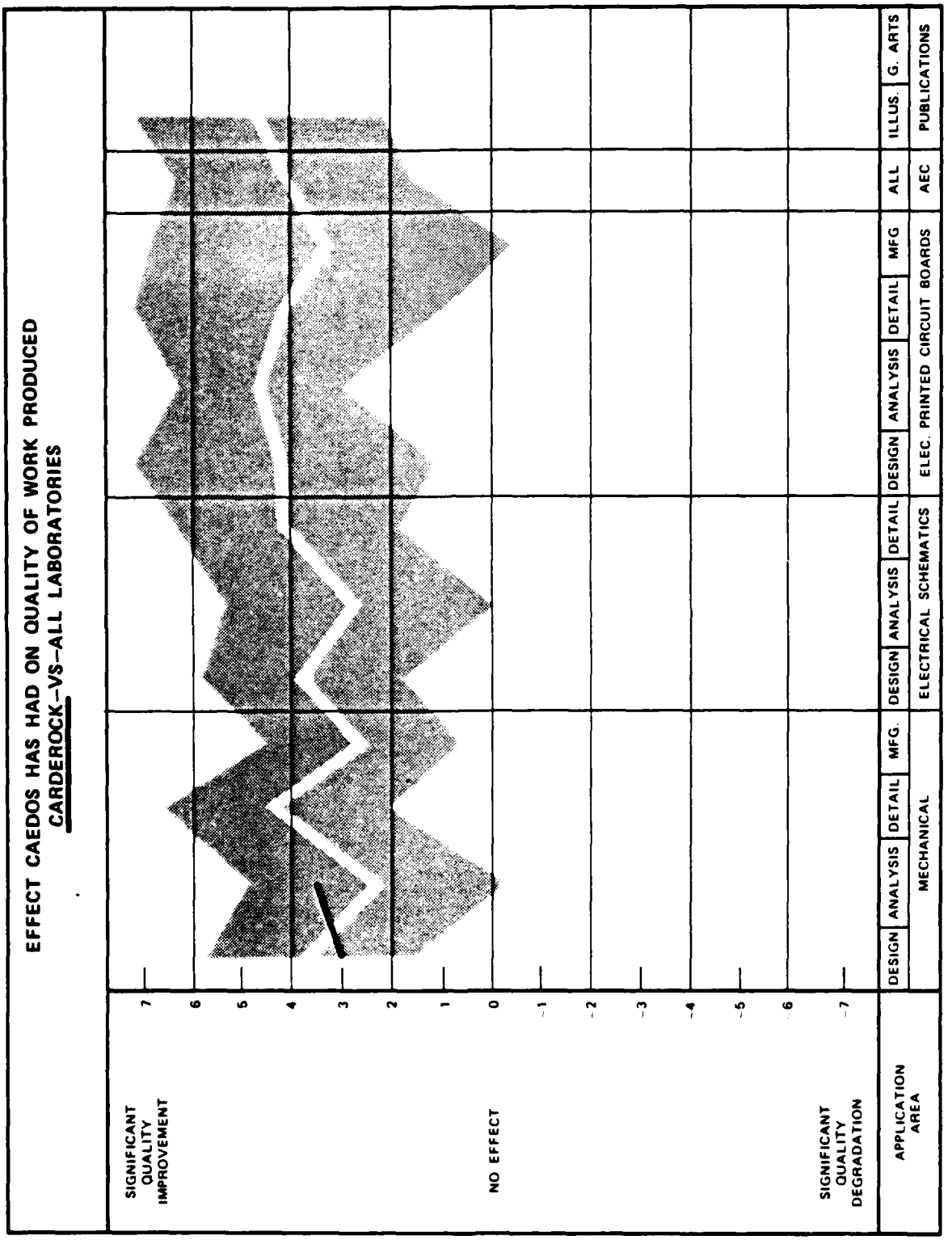
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS


EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
CARDEROCK–VS–ALL LABORATORIES
SIGNIFICANT QUALITY IMPROVEMENT
NO EFFECT
SIGNIFICANT QUALITY DEGRADATION
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APPLICATION AREA
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ANALYSIS
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MFG.
MECHANICAL
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ANALYSIS
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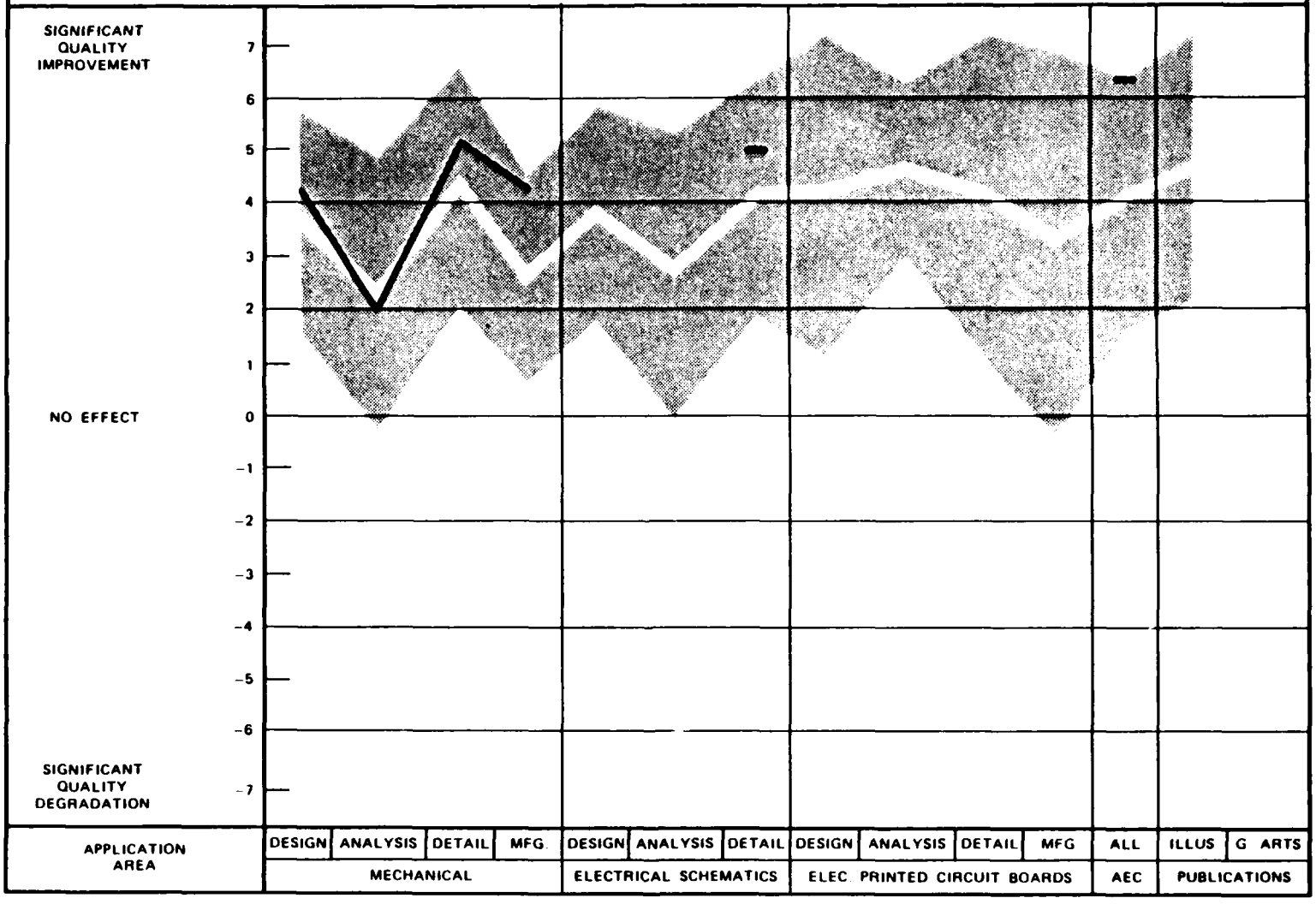
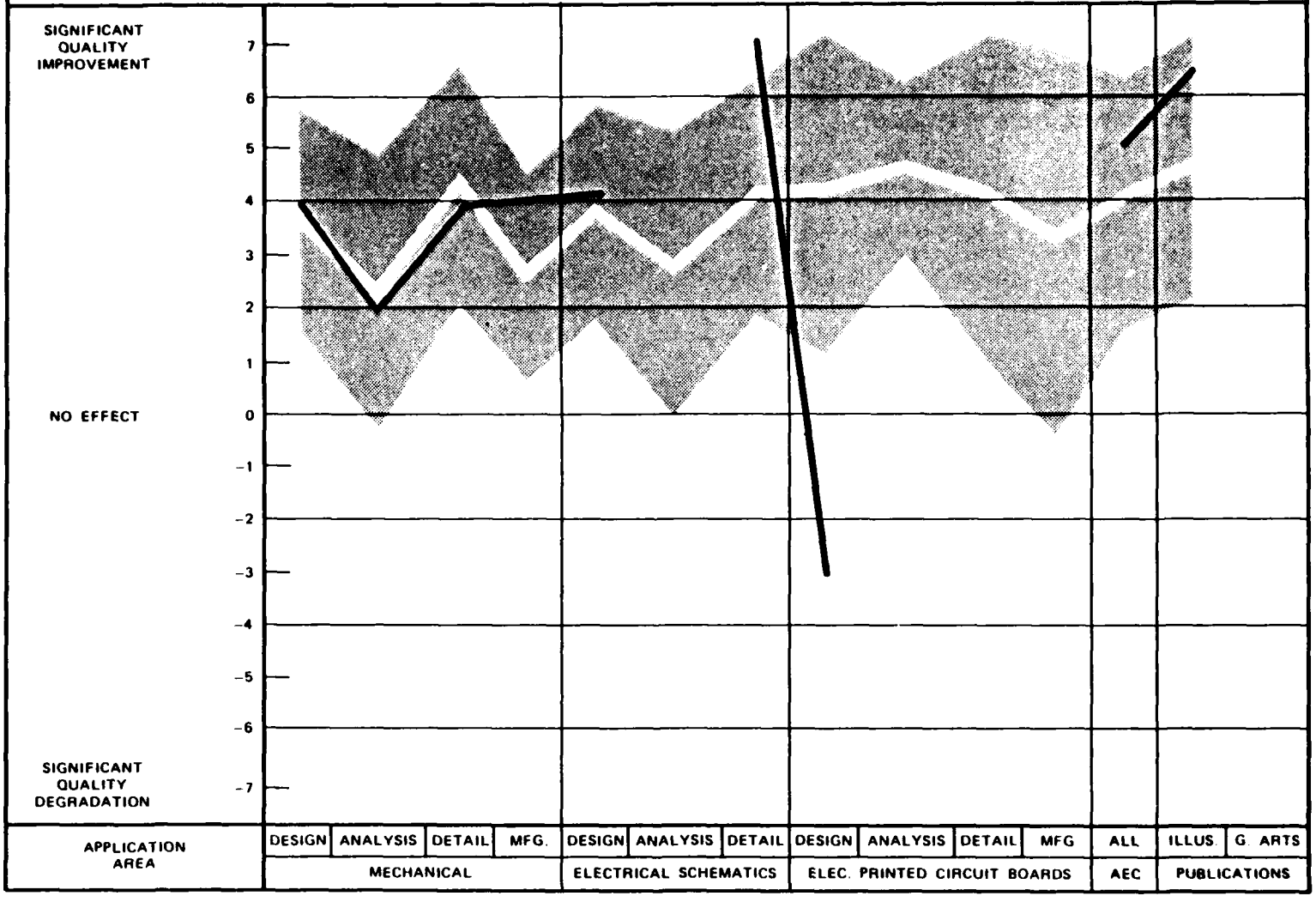
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS

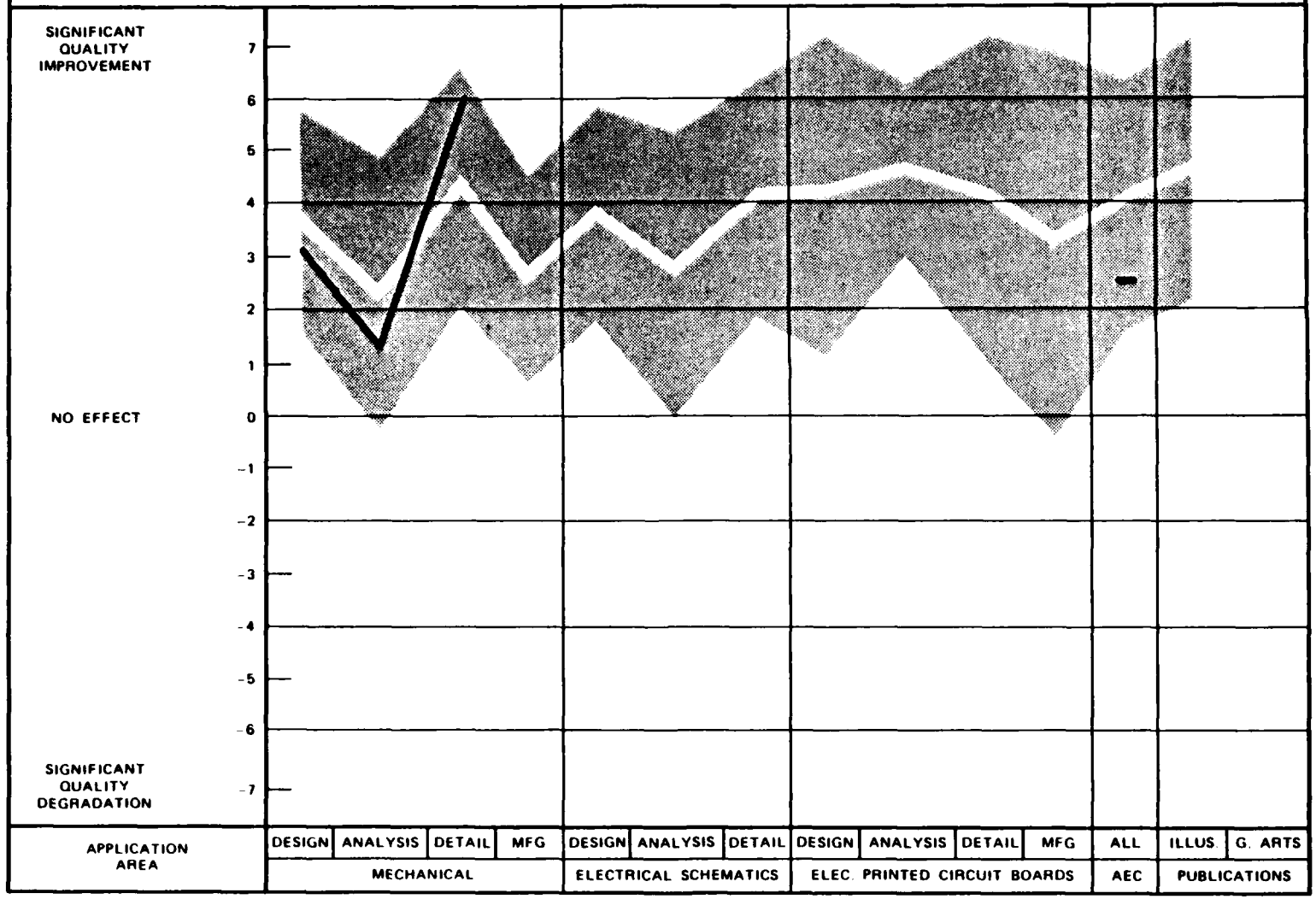
EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
DAHLGREN–VS–ALL LABORATORIES

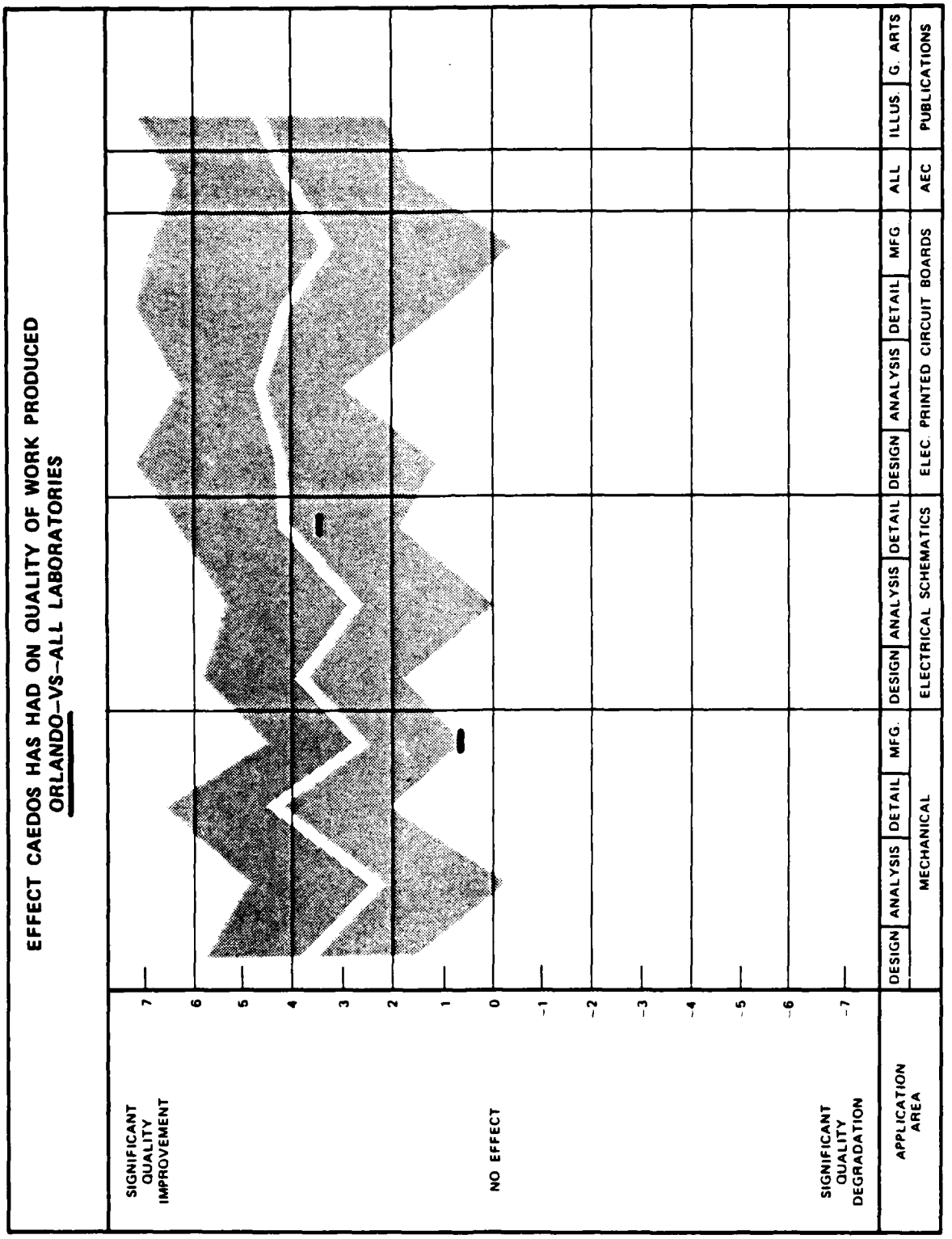


EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
NEW LONDON–VS–ALL LABORATORIES



EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
NEWPORT–VS–ALL LABORATORIES




EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
ORLANDO–VS–ALL LABORATORIES
SIGNIFICANT QUALITY IMPROVEMENT
NO EFFECT
SIGNIFICANT QUALITY DEGRADATION
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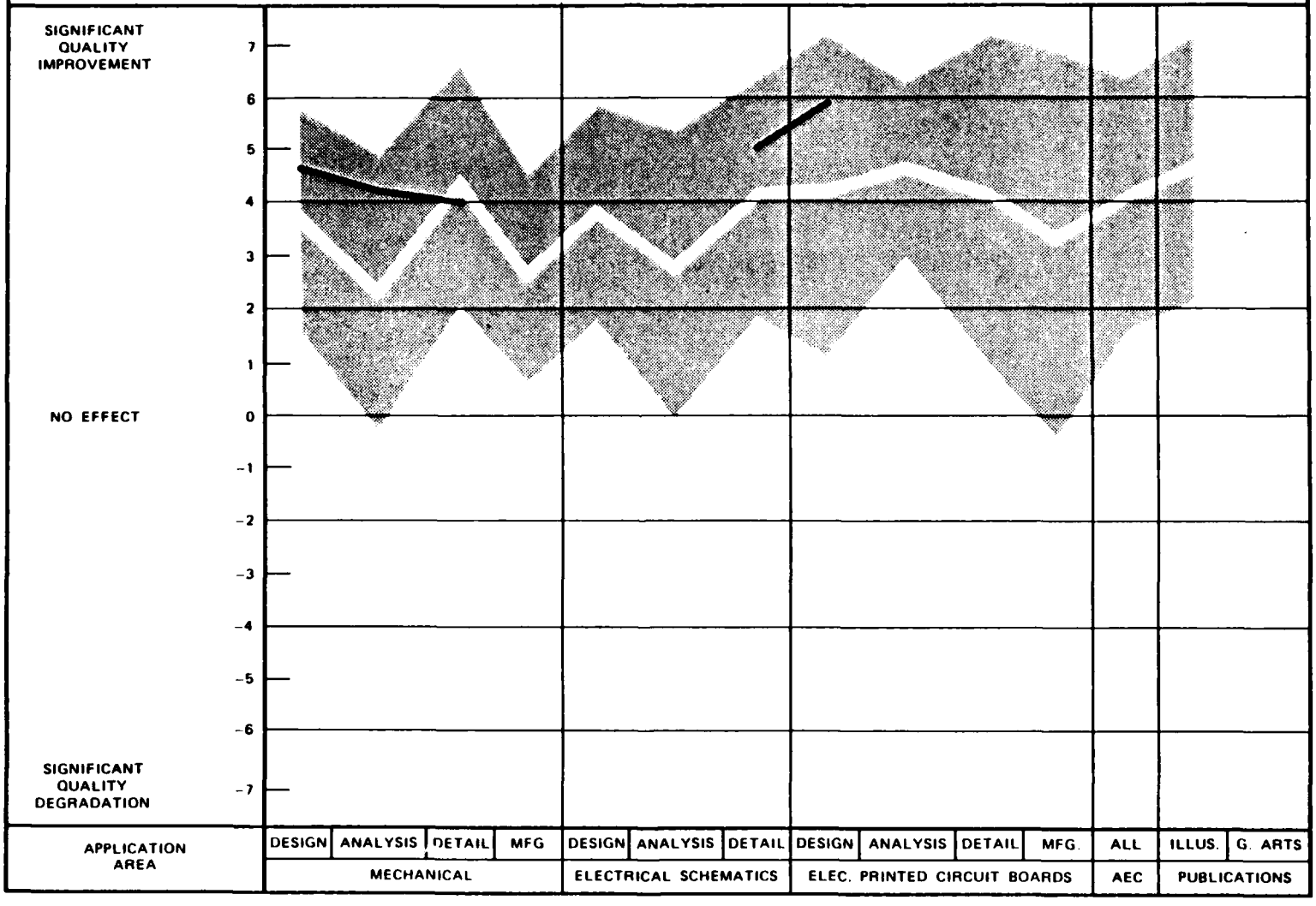
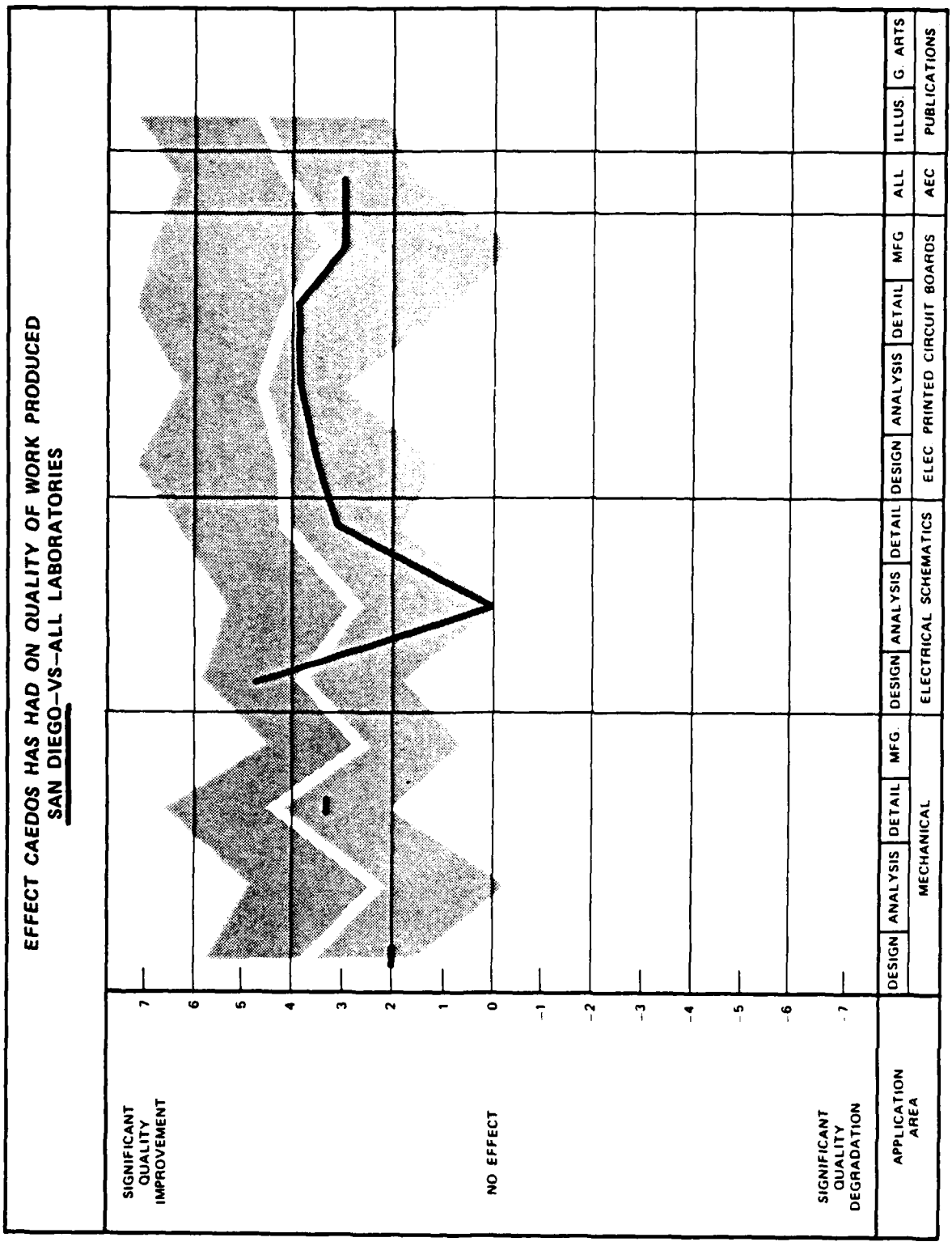
APPLICATION AREA
DESIGN
ANALYSIS
DETAIL
MFG.
MECHANICAL
DESIGN
ANALYSIS
DETAIL
ELECTRICAL SCHEMATICS
DESIGN
ANALYSIS
DETAIL
MFG
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS

EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
PANAMA CITY–VS–ALL LABORATORIES




EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
SAN DIEGO–VS–ALL LABORATORIES
SIGNIFICANT QUALITY IMPROVEMENT
NO EFFECT
SIGNIFICANT QUALITY DEGRADATION
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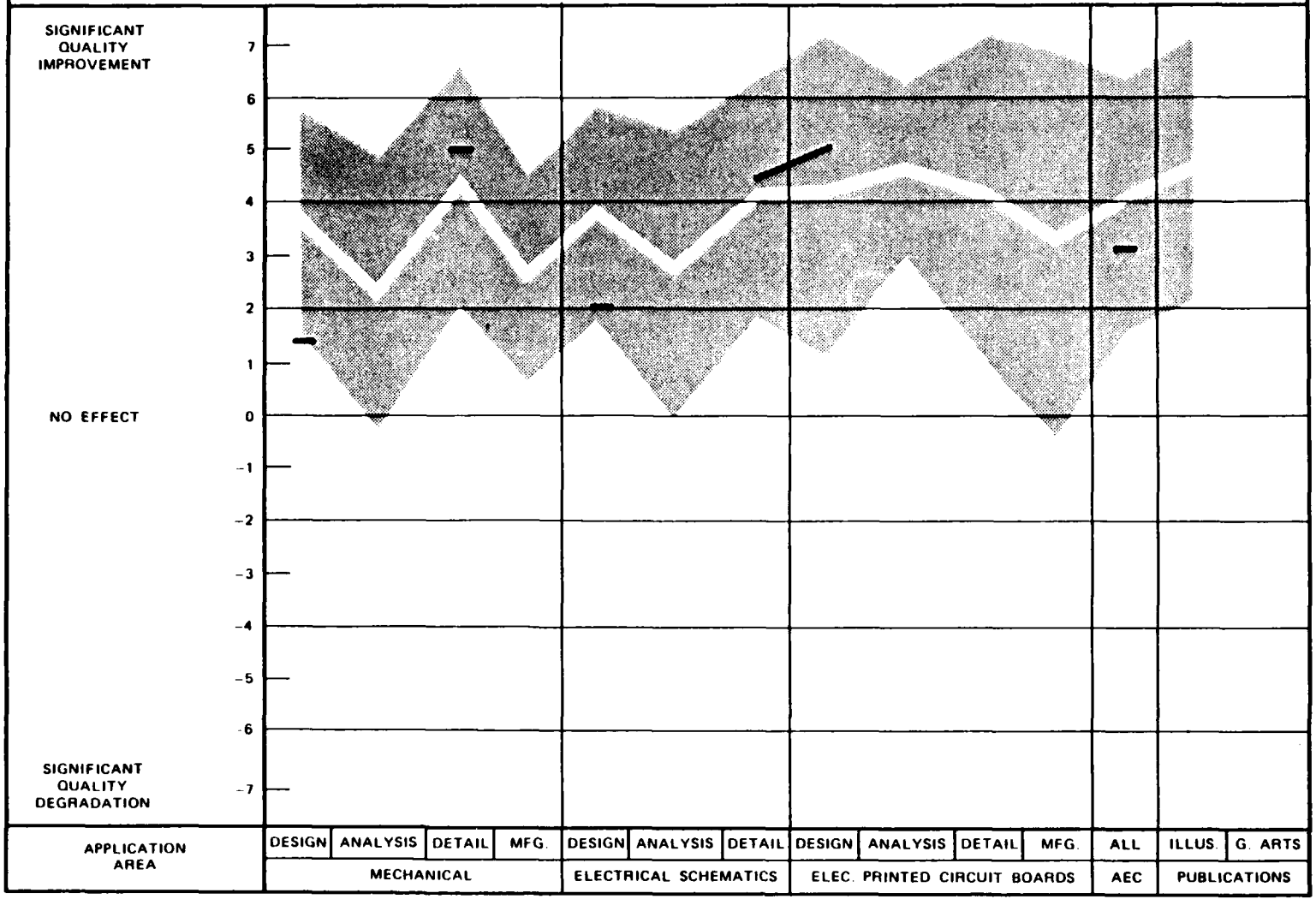
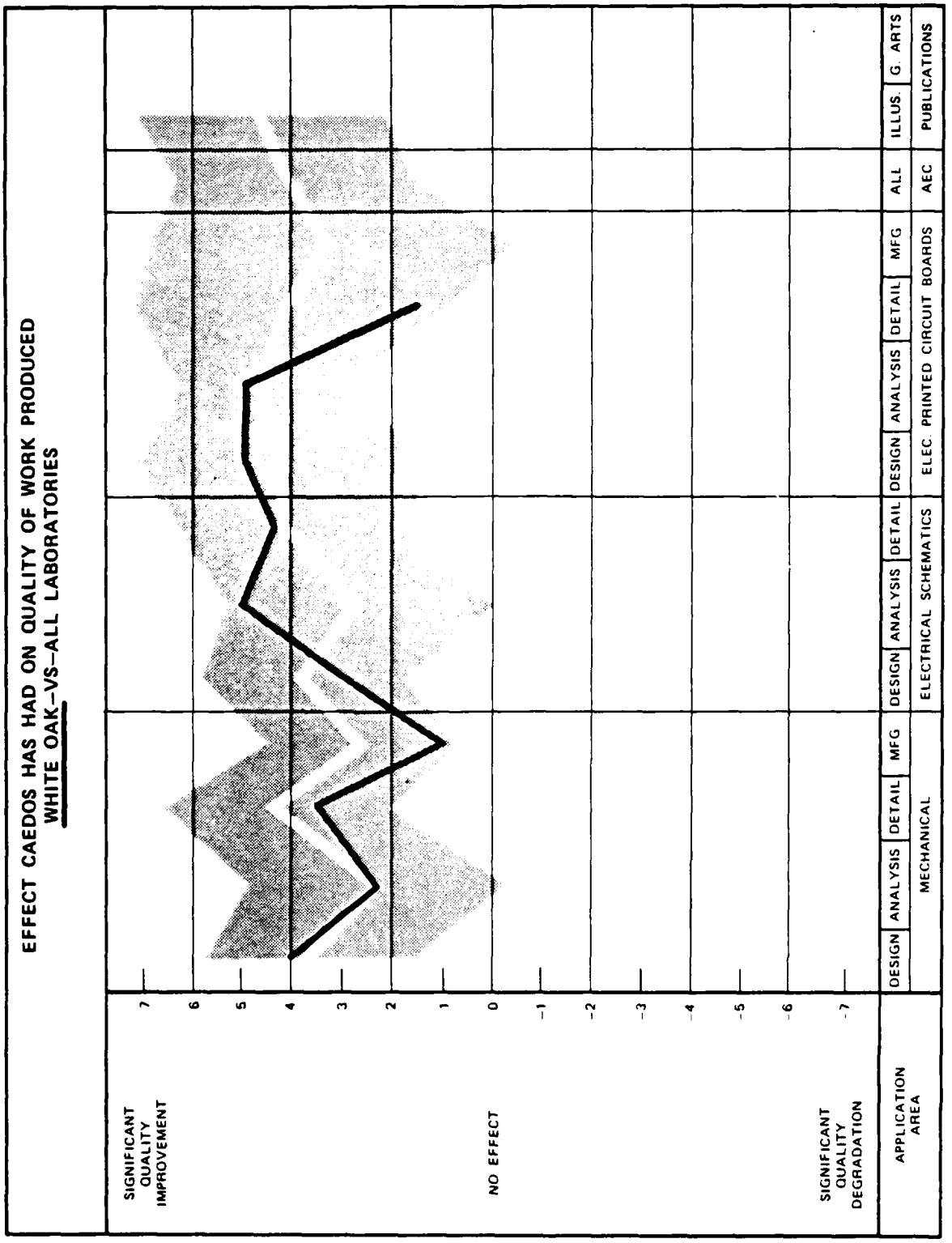
APPLICATION AREA
MECHANICAL
ELECTRICAL SCHEMATICS
ELEC PRINTED CIRCUIT BOARDS
AEC
PUBLICATIONS
DESIGN
ANALYSIS
DETAIL
MFG.
ILLUS.
G. ARTS
ALL

EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
WARMINSTER–VS–ALL LABORATORIES




EFFECT CAEDOS HAS HAD ON QUALITY OF WORK PRODUCED
WHITE OAK–VS–ALL LABORATORIES
SIGNIFICANT QUALITY IMPROVEMENT
NO EFFECT
SIGNIFICANT QUALITY DEGRADATION
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APPLICATION AREA
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ELECTRICAL SCHEMATICS
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MFG
ELEC. PRINTED CIRCUIT BOARDS
ALL
AEC
ILLUS.
G. ARTS
PUBLICATIONS

Appendix N

NAVY LABORATORY CAD/CAM SURVEY

Comment Code Definitions

Comment Code Definitions

Code	Comment	Times used
501	Require hidden line removal capability (equivalent to Code 551)	0
502	System downtime is unacceptable	9
503	Basic CV software and new revisions contain many software "bugs" that take extended time to fix	49
504	More efficient standard electrical parts library useable with all software releases is required	21
505	Additional training is required	135
506	Laboratory needs additional software packages to make system productive	62
507	The CV photoplotter is operationally unsatisfactory	5
508	The CV system is unfriendly and difficult to learn	28
509	High disk drive utilization or too many workstations causes system slow down (response time)	17
510	A standard part numbering system is not available	0
511	A standard archiving procedure is required	1
512	Parts libraries occupy too much disk space	1
513	More efficient standard architectural parts libraries useable with all software releases is requied	12
514	Install ABAQUS or suitable interface on the CV system	4
515	Require direct interactive on line communications between CV system and mainframe or super mini (VAX) computers	12
516	System response time is much too slow	33
517	Local system management and support for the users of CV system requires improvement	32
518	Require a solids modeling capability	17
519	CV system should include color plotter	1
520	CV system requires a broader selection of text fonts	4
521	NC postprocessors to operate on the CV system are requied	7
522	Better written and indexed training manuals are required	6
523	CV engineering design databases cannot be used as source for NC programming	6
524	Require much more CAE software than is now available on the CV system (equivalent to Code 560)	6
525	Inability to write Fortran programs for the CV system severely limits local application development	12
526	Upgrade from CADDS 4 to 4X is required	17
527	The CV system requires an efficient pen plotter	4
528	A library of weld symbols is required for the CV system	1
529	CV should maintain upward compatability between successive software releases (versions)	2
530	CV system requires improved capability in handling text	2
531	More effective dimensioning software is required	3
532	The CV technical manuals for NC applications are either poorly written or nonexistant	1
533	CV system should include a facility to notify users immediately of imput errors	6
534	Improved PCB routing software is required	4
535	Question exists as to whether all applications should use NAVFAC or local laboratory software (i.e., libraries, standards)	1
536	CV system maintenance support and repair services are slow and not responsive to the laboratory requirement (equivalent to 552)	14

Comment Code Definitions (Contd.)

Code	Comment	Times used
537	The CV system requies an interface with the IBM PC or other standalone CAE workstation to extend its usefulness	8
538	CV system requires more accurate plotters	0
539	A more efficient and useable FEM generator is required on the CV system	2
540	PATRAN G pre- and postprocessors are required on the CV system	1
541	CV generated NC parts will not interface with non-NC generated parts	1
542	Quality of work and output is as much a measure of productivity as time saved	1
543	Existing NC capability on CV system is underutilized	1
544	CV system as presently configured is not suitable for use in a CNC environment	1
545	New stand-alone workstations should interface with the CV system (equivalent to 537)	1
546	CV documentation is incomplete, sometimes inaccurate and not always understandable	4
547	Need a stress analysis capability (duplicate assigned)	2
548	CAEDOS is not integrated with the laboratories manufacturing capability	1
549	CV's electronics capability is worthless	2
550	A circuit analysis capability is required in the CV system	2
551	Hidden line removal capability is required on CV system (equivalent to 501)	7
552	The laboratories required an on-site maintenance engineer and improved maintenance support (equivalent to 536)	2
553	CV interface with a system to produce viewgraphs would be helpful and useful	2
554	Expanded AEC software capability is required in the CV system	4
555	An animation capability is required in the CV system (equivalent to 580)	1
556	CV's error messages are misleading, inaccurate, not always useful and frequently cause extended production delays (CV FEs and SBs not always helpful)	11
557	More workstations or terminal hours are required in the respondent's department	25
558	An interference checking capability is required	2
559	PATRAN G capability is required (equivalent to 540)	1
560	A more friendly finite element modeling capability with finite element pre- and postprocessors is requied on the CV system (equivalent to 524)	8
561	The CV system does not provide an effective thermal analysis capability	2
562	The CAEDOS (CV) system is being used primarily as a drafting system	4
563	CV system requires an improved autorouting capability (equivalent to 534)	2
564	Require CAE pre- and postprocessors (equivalent to 560)	4
565	Require an advanced surface design capability on the CV system	3
566	The CV system is not stable	10
567	CV system requires more reliable plotters (equivalent to 568)	6
568	CV system requires more reliable plotters (equivalent to 567)	5
569	Considerable work is lost due to the system going down	3
570	Corrections for all 32 and CADD fatal errors are ugently required on the CV system	2
571	Laboratory requires installation of the CV APU 32 bit processor	1
572	FEs are not trained and take too long to respond and too often have unservicable parts	1
573	Require a design analysis and dimensioning capability	2
574	CV system has improved much during last year	1
575	Laboratory requires a stand-alone CAD/CAE system (equivalent to 537)	1
576	Require printer with CV system in respondent's department	3
577	CADDS 4X much faster than CADDS 4	2

Comment Code Definitions (Contd.)

Code	Comment	Times used
578	CV maintenance personnel respond rapidly to service calls	1
579	CAD/CAM facilities area should have a reference area for prints, samples of hardwre, etc.	3
580	CV system requires an animation capability (equivalent to 555)	0
581	CV is slow to respond to user needs for new and improved software	0
582	Requirement for KIWE simulations software	1
583	CV system requires improved and more extensive drafting software	1
584	CV system requires a larger digitizer tablet	1
585	Require the capability to run SDRC software on CV or interface CV with SDRC	2
586	Many CV system features are not utilized due to managers and engineers lack of knowledge of system, in 3-D modeling, parts listing, etc.	1
587	Insufficient time allocated to new application development on CV system	1
588	Existing electronic schematics and PCB libraries are not properly constructed	2
589	CV hardware is outdated	7
590	CV software is outdated	3
591	CV APT source output is inadequate to and not readily useable with non-CV postprocessors	3
592	Active real-time design rule check is required	1
593	Require an AEC parts library that is efficient and easy to use and useable on all releases of CV software	2
594	CV *HUAC and piping for* AEC applications are installed but not yet available to users	1

Appendix O

PRODUCTIVITY STUDY—COMMENTS TALLIED BY LABORATORY

PRODUCTIVITY STUDY

Comments	Laboratories											
	Annapolis	China Lake	Carderock	Dahlgren	New London	Newport	Orlando	Panama City	San Diego	Warminster	White Oak	Total
501												0
502				1	7				1			9
503		7	1	1	7	1		2	9	15	6	49
504		8			1	1		2	2		7	21
505	6	45	2	9	5	7	6	8	12	12	23	135
506	3	8	2	2	9	6	1	1	18	4	8	62
507				1				3	1			5
508		8		1	1	1	6	2	3		6	281
509	3	3			4	1		2		2	2	17
510								1				1
511								1				1
512				1								1
513		1	2						4		5	12
514	1							1			2	4
515				3		3			1		5	12
516		6		1		6			9	5	6	33
517	2	3		1	14	3		2	1	1	5	32
518	1	1	1	2	6	2			2		2	17
519				1								1
520				3						1		4
521		2		2					1		2	7
522		5		1								6
523				1								1
524	1			1	1				3			6
525	1			2							9	12
526		3			2	3	4		3	2		17
527		1					2		1			4
528									1			1
529		1							1			2
530									2			2
531		2							1			3
532									1			1
533									4		2	6
534		3							1			4
535									1			1

PRODUCTIVITY STUDY (Contd.)

Comments	Laboratories											
	Annapolis	China Lake	Carderock	Dahlgren	New London	Newport	Orlando	Panama City	San Diego	Warminster	White Oak	Total
536			2		3					9		14
537	1	3			3				1			8
538												0
539					2							2
540					1							1
541					1							1
542					1							1
543					1							1
544					1							1
545					1							1
546		1			2				1			4
547					2							2
548					1							1
549					2							2
550											2	2
551	1	1			4			1				7
552					1					1		2
553					2							2
554		1			2	1						4
555					1							1
556		10			1							11
557	2	14				2				4	3	25
558	1	1										2
559											1	1
560		3				4				1		8
561						2						2
562						2					1	4
563						1					1	2
564								1			3	4
565			1					2			3	6
566		4	2					1		2	1	10
567						2				1	3	6
568		3				1					1	5
569										3		3
570										2		2

PRODUCTIVITY STUDY (Contd.)

Comments	Laboratories											
	Annapolis	China Lake	Carderock	Dahlgren	New London	Newport	Orlando	Panama City	San Diego	Warminster	White Oak	Total
571										1		1
572										1		1
573											2	2
574											1	1
575											1	1
576											3	3
577											2	2
578											1	1
579											3	3
580												0
581												0
582		1										1
583		1										1
584		1										1
585		2										2
586		1										1
587		1										1
588		2										2
589		7										7
590		3										3
591		3										3
592		1										1
593					1				1			2
594						1						1
595					1							1

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